ENGINEERING NEWS

ANOTHER NEW ORLEANS BRIDGE, over the Mississippi river, has been chartered in that city, to be connected with the railways on both sides of the river. A bill authorizing its construction has been forwarded to Congress for action. The promoters of this structure say that a bridge above the city, with the proposed elevation of 75 ft. above high water, would necessitate at least 2 miles of approaches on each side; and as such a bridge would be exposed to heavy day and night steamboat travel, the channel span would have to be very wide to reduce chances of accident. The main span of the Memphis bridge was fixed at 1,000 ft. by the Board of Engineers. The bridge now proposed would cross at the lower limits of the city and have a draw-span, with the river traffic almost wholly in the day time.

Mr. E. L. CORTHELL has been interviewed by a *Times-Democrat* reporter, on the comparative merits of the locations, and says that the banks of the river below the city are not so solid as claimed, but even now call for protection; a draw-bridge scheme would require more metal in the trusses than a high level cantilever bridge, and would require at least 4 piers in the river, where the bridge he proposes would only have two piers. As the water alone is from 76 to 100 ft. deep in both cases, it is easily seen that the most expensive part of such a bridge is under water; especially as to be safe under the conditions, the foundations must extend 150 ft. below low water.

Mr. CORTHELL says that the upper bridge will only be about 2¼ miles long all told, with grades no heavier than on the St. Louis bridge. The plans for the upper bridge call for two channel spans, one on each side of the river, of 800 ft. each in the clear at low water, and a clear height underneath of 75 ft. These channel spans may be increased in length.

He says his bridge will be more convenient for the Western railways in reaching a central passenger station, and that a low bridge in the lower part of the city will be dangerous to vessels, and in danger itself from vessels, owing to the frequent dense fog, or in case of fire among the shipping and of vessels going adrift.

A RACK RAILWAY is to be built up Monte Generoso, the highest peak on the Swiss-Italian frontier. The line will run from Capolago, on the Gothard Railway, to Vetta, 5,400 ft. above sea level; it will be 5½ miles long, and the actual rise will be 4,490 ft The Abt system is to be adopted, and the journey is expected to occupy about 1¼ hours. The capital stock of the company is $4,000,000.

THE OWINGS BLOCK FAILURE, in Chicago, was not so bad as first reported. Ten of the landing floors near the elevator shaft fell one after the other, leaving an opening 5½ ft. by 20 ft. The architect claims that the cause was the hoisting of an 1,800 lb. elevator tank on to the tenth floor, while the tiling mortar was still green and the opening unbraced by the stairways. It is now said that the main walls of the building are uninjured, and that a few hundred dollars will repair the damages.

THE CHARLESTON, CINCINNATI & CHICAGO railway enterprise is receiving considerable attention now because of the recent announcement that capital has been definitely secured and contracts closed for the completion of the road. The line is now completed and in operation from Kingville, S. C., to Rutherfordton, N. C., 187 miles. The Massachusetts & Southern Construction Co., of 45 Broadway, this city, have recently let contracts for 90 miles more to McDonald, Shea & Co., of Knoxville, Tenn., and it is stated that the same firm have an option on the remaining 100 miles of the mountain division. They are to begin grading at once, and will work north and south from Johnson City, Tenn., on the East Tennessee, Virginia & Georgia railway.

The road when completed will extend from Charleston, S. C., to Ashland, Ky., a distance of over 400 miles air line. The principal feature which recommends the enterprise, however, is the mineral deposits which will be developed by its construction, and it is this, rather than any expectation of securing through traffic, which has induced capitalists to advance the funds for its construction.

A NEW MAP OF RHODE ISLAND has been completed as far as the field-work is concerned. The work has been carried out by the U. S. Geological Survey and the State, each equally sharing expenses. With Massachusetts and New Jersey, 3 States now by wise co-operation with the U. S. Geological Survey have secured excellent topographical maps of their territory. All of the others should do likewise.

THE WASHINGTON AQUEDUCT FRAUD has resulted in the recommendation by the joint Congressional Committee that the tunnel be re-lined at an estimated cost of $750,000. The report of the Board of Experts fully corroborates the testimony of the witnesses relating to the worthless character of work done.

A difficulty in enforcing these terms upon the original contractors is said to face the committee. The old contract is thought to be rather loose in its terms and they have not yet ascertained that the $250,000 bond is valid and applicable to this purpose. It may turn out that the Government will have to repair the defective work at its own cost.

A CHILIAN RAILWAY, 700 miles long, is said to have been contracted for with the Government by Mr. JAMES ROSS, of Canada, for $22,000,000. The London *Railway News* is apparently mixing up Mr. Ross as principal with the North and South American Railway Syndicate of this city.

BELLITE, the new explosive, was subjected to some further experiments in England on Feb. 5, to prove its power and its remarkable safety under ordinary circumstances. Bellite was thrown in the fire, and fused and sputtered without explosive force; a 120-lb. weight was let fall on 1 lb. of naked cartridges without explosion, and when 1 lo. each of bellite and gunpowder were placed in a hole 1 ft. deep and the powder exploded, the bellite cartridges were simply thrown out unexploded. To prove its power, ¼ oz. of best rifle powder was put in a mortar and a 32-lb. shot projected 121 ft.; ¼ oz. of bellite threw the same shot 300 ft.; then 60 ft. of ordinary railway was totally demolished by 8 lbs. of bellite placed in a 3-ft. hole under the track.

A HORRIBLE CALAMITY occurred at Hawkesbury bridge, Sydney, New South Wales, on Dec. 13, as reported in the Melbourne *Argus*. Mr. RYLAND, of Ryland & Morse, sub-contractors for the erection of the superstructure of the bridge, was walking along the top of one of the spans when he missed his footing and fell some 50 feet into the river below. Even as he was falling, a huge shark was observed immediately below, and the unfortunate man had scarcely reached the water when the monster seized him, and both disappeared under the water, which at once became tinged with blood. A number of workmen and others on the bridge who witnessed the accident remained horror-stricken and helpless. The deceased, who, with his partner, was just bringing to a successful close a contract of considerable magnitude, was a middle-aged man, and has left a widow and family well provided for.

THE FIRST ELECTRIC CRANE ever built in the United States has just been introduced in the foundry of E. P. ALLIS & Co., of Milwaukee. It is a ponderous affair, weighing 30 tons, and is capable of lifting and carrying to any part of the foundry, with ease, a weight of 25 tons. The crane is of the usual traveling girder type suspended on tracks built on each side of the foundry, near the ceiling. It is provided with 3 electric motors. One moves the crane from one end of the foundry to the other, another moves the carriage with which the crane is provided from one side of the foundry to the other and the other runs the lifting machinery. Its advantage over the ordinary power traveling crane which it resembles somewhat, is a saving of power and the wear and tear of machinery. The only other electric crane known is said to be in an English foundry, the latter being supplied with only one motor, rendering clutches and complicated gearing necessary.

COPPER AND ZINC PRODUCTION in the United States, according to a statement just issued by the Geological Survey, has been as follows:

	Tons of 2,000 lbs. Copper	Zinc.
1882	45,823	33,765
1883	53,576	36,872
1884	73,903	38,544
1885	85,481	40,688
1886	80,618	42,641
1887	92,335	50,340
1888	115,202	55,913
Incr. p. c. 6 years	151 %	65½%

The greatest increase in copper has been in Montana, which shows the enormous jump of 48,949 against 4,529 tons in 1882. Lake Superior has increased about 52 per cent. to 43,202 tons, and Arizona about 76 per cent. to 15,899 tons. All the rest of the country shows only 4,697 tons against 3,310 tons in 1882, the increase lying wholly in product of imported pyrites, 2,455 tons in 1888 against 500 in 1882.

COPPER CONSUMPTION, meantime, owing to the effect of the iniquitous copper combine to artificially inflate prices, is estimated to have fallen off 7.68 per cent. since last year, whereas it should, under natural conditions, according to all indications, have increased about 14 per cent. The present price is about 16½ cts. The load carried by the French syndicate of course is increasing rapidly, and it can hardly be doubted that it will collapse in time, since the burden it is carrying is constantly growing.

AN ADJUSTABLE LOCOMOTIVE HEADLIGHT is described by the Pittsburg *Dispatch*. It is so arranged as to enable the engineer to direct his light to any desired point, the light moving to the right or left on a vertical axis. No further details and no name of inventor given.

AN AIR BRAKE, automatic in its character, has been invented by A. R. BOLUSS, of Norwood, O., and is said to be working successfully. The distinctive feature claimed is the ability of the engineer using it to commence braking at the rear of the train and "thus avoid the jarring of the cars coming together"—a jarring which does not now occur with the Westinghouse brake.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision, Feb. 13, on the Chicago, Burlington & Quincy, at St. Augustine, Ill. A freight and passenger train collided, owing to the former running on too short time and failing to reach the switch to the side-track. Both engines were wrecked and the baggage and express cars telescoped. One man was killed.——A freight train collision occurred Feb. 15 in tunnel No. 17 on the Concinnati Southern, near Oakdale, O. A stove set fire to oil from broken tank cars, and the wreck was burned; the timbering of the tunnel was also burned and a quantity of debris fell from the roof. ——A slight collision on the Brooklyn bridge occurred Feb. 19. Switch engine No. 8 was backing down from the water tank. A car was being run down in the same direction on a parallel track. The two struck the switch at the same time, and the collision threw the car off the rails and smashed a little woodwork. Travel was not delayed.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: On Feb. 12 a freight engine and 2 cars broke through a bridge near Caliente, Cal.——A trestle near Gillsville, Ga., was burned last week.

STORMS AND FLOODS are reported from different sections of the country, but the damage thus far is comparatively light, owing to the mildness of the season. A snow-storm near Buffalo, N. Y., early in the week caused some interference with railway traffic. At Kalamazoo, Mich., and Augusta, Ga., floods have caused some damage to dams. A cyclone occurred in Alabama and Georgia on Feb. 18.

A LOCOMOTIVE BOILER EXPLOSION occurred Feb. 15 on the North Pennsylvania division of the Philadelphia & Reading. The engine was a big "camel-back" and was taking a train up the heavy grade from Center Valley to Coopersburg when the accident occurred. The boiler was blown from the frame. Two men were killed and one was injured.

THE GROWTH OF ATLANTA, GA., as a manufacturing center, is well illustrated by the statement, published in the *Constitution*, that in 1870 the total consumption of coal in that city was 2,700 tons, while in 1888 it was 300,000 tons. In the same article it is stated that in Alabama alone, in 1888

twice as much iron was made as was made in all the States of the Union in 1840, while the whole South in 1888 made more iron than all the States of the Union made in 1860.

RECEIVERS HAVE BEEN APPOINTED for the International & Great Northern Railway, a part of the Missouri Pacific system in Texas. The system has an extent of 825 miles, reaching from Longview, in the northern part of the State, south to Galveston, on the Gulf coast, and Laredo, at the Mexican boundary, the northern terminus of the Mexican National Railway.

THE NEW YORK, NEW HAVEN & HARTFORD and the Housatonic railroad companies are having a sharp fight over the privileges which the latter company wishes to secure from the Connecticut Legislature. The Housatonic managers openly avow their intention of paralleling the New York, New Haven & Hartford road from New York City to New Haven. All they ask is the right to build branches to their road not more than 30 miles in length, a right which all other railways in the State possess under the general railroad law, but of which the Housatonic is deprived by its charter limitations.

The main object of the extension, it is generally believed, is to give the New York & New England system a direct line to New York. For although the Housatonic is an independent company, many of its heaviest stockholders are also interested in the New York & New England. It is probable that the route adopted would be some one of those for which surveys have been made by independent companies during the past few years. It is stated that the Housatonic company has already purchased some of these unexpired charters, and if it fails to obtain what it asks from the Legislature, it may still make use of one of these to parallel the New Haven road.

THE NICARAGUA BILL has become a law by the signature of the President, which it is unofficially stated was postponed a week only to enable a full investigation to be made of the truth of claims in behalf of rival projects and concessions which came pouring in on the President after the bill reached him, and which have all been found after investigation to be without any standing in law or equity. The bill empowers the projectors to organize with a capital stock of $100,000,000, with the privilege of increasing to $200,000,000 if desired, and is without any of the objectionable features which the House introduced in the bill when it first reached it.

WORK ON GREYTOWN HARBOR will begin at once, it is stated, the first necessity being to obtain about 15 ft. of water in it, which it is expected will be done in about 2 months, and then work will begin all along the line. The company now has upwards of $2,000,000 in its treasury for starting all this preliminary work, and has already obtained, we are informed, the most gratifying assurances from capitalists as to raising the total capital necessary for construction. Commander ROBLEY D. EVANS, now Naval Secretary to the Light House Board, has been granted a year's leave of absence, and will go to Nicaragua as Superintendent of Construction.

THE EVANSVILLE & TERRE HAUTE OR MACKEY Railway system bids fair to become the most important one of the group of systems lying between Chicago and the Ohio river. The system at present comprises the Evansville & Terre Haute and Peoria, Decatur & Evansville railways, consisting of two lines of railway from Evansville to Terre Haute Ind., and one from Evansville to Peoria, Ill., making with branches a total of 571 miles. It is now announced that the syndicate headed by President MACKEY has purchased the Louisville, Evansville & St. Louis railway system, extending from Louisville, Ky., west to Mt. Vernon, Ill., with several branches, a total mileage of 276 miles. It is also stated that control has been secured of the Illinois & St. Louis, extending from St. Louis east to Belleville, Ill., 16 miles. It is proposed to build an independent link from Belleville to Mt. Vernon, about 60 miles. This when completed would make the total extent of the MACKEY system about 925 miles. Still another road for whose control Mr. MACKEY is said to be negotiating is the Ohio Valley Railway in Kentucky. This is in operation from Henderson to Princeton, Ky., with branches, 98 miles. An extension to Evansville, Ind., crossing the Ohio river by a ferry transfer, is now nearly completed, and local aid and right of way have been secured for an extension from Princeton, Ky., south to Hopkinsville, and from that point probably to Florence, Ala.

Besides the above lines, Mr. MACKEY is at the back of a proposed line across southern Indiana, 150 miles in length, from Elnora to Richmond, on 80 miles of which the graders are now at work. It is thus quite certain that the whole MACKEY system will within a few months have a total extent of at least ten or twelve hundred miles.

ELEVATED ROADS are not wanted in Philadelphia if their usefulness is to be measured by the vigorous protests of citizens claiming to represent $500,000,000 to $800,000,000 of property. These citizens ask the mayor to veto the ordinance authorizing the construction of the Northeast Elevated railway on the ground that it will injure private property. As we before remarked, every Philadelphian wants rapid transit, on the one condition that the road is located before some other man's door.

THE ASSEMBLY CEILING, in Albany, N. Y., is the subject of a scathing report from the commission of experts appointed to examine it. They find a direct violation of the act authorizing this ceiling, that the plans call for 768 panels, while only 396 have been constructed, with a proportionate less cost in iron-work, and the woodwork of the ceiling is not quartered oak, as called for in the specifications.

The panels were to be flat quartered oak, or vaulted papier-machè panels, at the option of the Superintendent. The panels furnished are of the latter material and it is proper in such panels; but wherever else used, it should be replaced with quartered and carved oak by the contractor, as called for in the specifications. Many items in the monthly statements of cost are excessive as to quantity and price, in some cases being double the actual amounts. The sum total of these monthly statements certified to by Supt. ANDREWS is $288,828, whereas the contract total is $270,150. The experts say a carved oak ceiling would have cost from $60,000 to $70,000 more than the present ceiling. They recommend that the contractor be made to replace improperly located papier-machè with oak at a cost of $10,000, and that $10,000 be deducted for reduced cost in iron-work by reason of decreased number of panels.

THE INTERSTATE RAILWAY ASSOCIATION has been the chief object of interest in financial circles this week. The Illinois Central directors held a long session on Feb. 20, and finally adopted resolutions declining to authorize President FISH to sign the Interstate agreement on behalf of the company, on the ground that by the terms of the company's charter, the directors have no power to delegate the fixing of rates to other parties, and that the company, therefore, cannot join the Interstate Railway Association without exceeding its charter powers. At the same time the directors declare that they "are determined to give the said proposed Association their moral support as far as may be consistent with the best interests of the company," and to further the Association's objects "in the establishment and maintenance of rates as far as they may conform to the laws of the various States in which its roads are situated, and with the Interstate commerce law."

At the meeting of the presidents of the companies in Chicago on Feb. 20, the committee appointed to secure signatures to the agreement reported that the Illinois Central had refused to join, and the Wisconsin Central had also refused unless the Chicago, Burlington & Northern became a member. No response has been received from the Missouri, Kansas & Texas, the Chicago, Burlington & Northern, and the Kansas City, Ft. Scott & Gulf.

It was decided to form the Association without the dissenting companies, and Messrs. HUGHITT, MCMULLEN, STONE, TRUESDALE, NEWMAN, and HOUSE were appointed a committee to make such changes in the proposed agreement as might be advisable because of the refusal of several companies to join.

THE ANNUAL DETAILED REP[illegible] hemileage of the Pennsylvania Railroad system, issued from the Chief Engineer's office, shows that on Dec. 31, 1888, the system had a total extent of 7,581.22 miles of railway and 12,510.31 miles of track. This is an increase of 96.10 miles of railway and 380.23 miles of track over the amount reported one year ago.

At Thursday's session, General Manager MILLEN, of the Wisconsin Central was present, and signed the agreement on behalf of his company. Vice-President HARRIS, of the Chicago, Burlington & Northern, was also present, but refused to sign. A committee was appointed to tender the Chairmanship to Mr. ALDACE F. WALKER, of the Interstate Commerce Commission.

M. DE LESSEPS is reported to be very ill. Old age seems to have suddenly fallen upon him as a result of the collapse of the Panama Canal scheme. It is reported that he is going to end his days at his villa at Ismaila. All efforts to revive the Panama company are completely abandoned, for the present at least, and in any case the active career of M. DE LESSEPS is over. He is now well started in his 84th year.

THE PANAMA CANAL work, meantime, has been almost completely shut down, and some thousands of laborers discharged, as yet without any of the disturbances which have been feared. There is a large naval force of all nations at each end of the canal which has perhaps helped to overawe lawless tendencies. In Paris, also, the results of the great collapse have been mild beyond all expectation. It now appears in the highest degree unlikely that any serious attempt will be made to continue work on the canal, which as late as 1887 had not been as completely surveyed and sectioned as the Nicaragua route has been before a yard of earth has been moved for it.

A REDUCTION IN TRAIN SERVICE is the method to be adopted by Western railway managers for cutting down operating expenses to correspond to the reduction in revenue. The Chicago, Burlington & Quincy has already reduced its train service on lines in Iowa 8,000 miles per month, and will make another reduction of equal amount soon. It is stated that other Iowa roads will take the same course. On the Missouri Pacific system, similar action has been taken, and it is stated that on the whole system the reduction will amount to 2,300 train miles daily.

STEAM HEAT is to be adopted on the Union Pacific system, and the order has been issued that all locomotives in the regular passenger service shall be equipped with steam-heating appliances in order that any of them may be used for the new "Golden Gate Special" vestibuled train. It is intended to fit up the regular passenger cars with steam pipes as fast as can conveniently be done.

Cylindrical Wheels and Flat-Topped Rails.

(*Concluded from from* 143.)

[Abstract of paper by DON J. WHITTEMORE, before the Am. Soc. C. E.]

In search of moduli for use in Prof. GRASHOF's formulæ, I have secured again, through the kindness of Mr. G. W. RHODES, of the Chicago, Burlington & Quincy Railway, the results of test specimens, cut from the heads of new and old rails, which are given in the following table:

[Two 1-in. cylinders 8 ins. long were turned out of the heads of rails side by side, and a ⅝-in. test shank 4 ins. long turned in the center of each, with results which we abstract and condense as follows:]

No. of rails.	When made.	Maker.	Wt. per yd.	Tensile str., lbs. p. sq. in.	Elas. limit lbs. p. sq. in.	P. c. elong'on in 4 ins.	Old or new rail.
8	1887	F	66	117,800	61,590	9.14	New
2	1871	"	"	70,740	40,350	12.70	"
5	1878	"	"	77,720	47,640	20.10	Old
2	1888	A	"	87,550	59,950	18.17	New
1	"	G	60	101,500	42,414	6.25	Old
10	1879-86	6 diff.	66	101,256	51,855	17.71	3 old
				74,606 to 126,200	36,200 to 78,300	10.0 to 30.0	7 new
2	1879-80	K	56	80,782	37,875	21.75	Old

I have also secured from GEORGE GIBBS, Mechanical Engineer of the Chicago, Milwaukee & St. Paul Railway, tests, chemical analyses, and photographic representations

of etched rails that have received severe service, which are given in the following table and sketches. [Figs. 1 to 5. We omit the extensive table, but give the analysis and physical test of each rail shown, which appear to be a fair sample of the rest of the table. The dark spots and lines in the cuts correspond to dark places in the etched sections, where the metal has been much etched out.]

It will be observed that these facts do not show any remarkable change through use. I take it as a fact that the cutting of test specimens relieves them from the internal stresses, as is supposed to be the case in reaming punched rivet holes in steel plates.

While the appearance of the photographic etchings can be sometimes observed in new rails, owing, as is believed, to faulty manufacture or design, yet fractures of this rail before use did not show such defects of structure. It is the slow but fatal development of an internal organic disease in a structure that is not organic, if we may borrow an idea from a present report—a sort of tuberculosis disease, with its slow-forming cavities.

It is beyond the intended scope of this paper to treat of the chemical composition of steel rails, yet it may be proper for me to incorporate an extract from a letter just received from the able manager of the Union Steel Co. of Chicago, Mr. ROBERT FORSYTH, as follows: "In regard to your inquiry as to the analysis of steel, I will say that we aim to make rail steel with: Carbon, .32 to .40 per cent.; silicon, .04 to .06; phosphorus, .09 to .105; manganese, 1.00 to 1.50 per cent. The amount of manganese is varied from time to time, to suit the character of the metal we may happen to be using. We have made a great deal of steel with phosphorus lower than .09, but we cannot as a rule do better, nor do I think it necessary for rails."

It is justly claimed, by the managers of rail mills, that the engineer of permanent way is deficient in knowledge of what practicable forms can be rolled with good results; and it is also natural to suppose that the proprietors of these works desire to limit their out-put to THE AMOUNT OF METAL THAT CAN BE SQUIRTED THROUGH THEIR ROLLS IN THE SHORTEST TIME, AND HAVE THE SAME ACCEPTED. [We take the liberty of putting that forcible sentence in small capitals.—Ed.]

We find, however, from an examination of forms sent us by rolling mill managers, that they can roll, with uniformly good results, as great a diversity of disposition of metal as the engineer of permanent way offers in his plans. This, however, is a branch of the subject of which it is not the purpose of this paper to treat. To such as wish light on this branch I refer to the paper on steel rails, by our Member, ROBERT W. HUNT, read before the American Institute of Mining Engineers, in October last.

From a scrap-heap I have caused sections of rail to be cut, which I now offer for your inspection, and in hope that others than those present may read this paper, I here offer sketches of these sections that they may see how rails fail with little abrasion. [Figs. 6 to 10.]

These rails were of the very best quality and had been in service from 5 to 8 years. Measurements taken of 20 of them show a wear of less than 1-32 in. and the loss of weight about 1 lb. per yd. How much of this was due to corrosion and how much to abrasion, we do not know, but I venture to say that there was twice as much from corrosion as from abrasion. Giving these sections the curve in head that they originally possessed, and with the web projecting into it, can we devise a better form for splitting the rail from the weight imposed by the wheel than is presented? Yet this is typical of universal practice. If my premises are true, we now see why 33-in. and 42-in. wheels, under our passenger equipment, render so much greater service than we have from the rail, which is subjected to pressures far beyond the elastic limit, through freight-car wheels and engine drivers. The wear of engine drivers shows better results than that of rails but it must be remembered that there is from two to three times more metal in their cross-section than in the rail, that there is a greater field for flow and disposition of stresses in the latter than in the former; and yet it is not an unheard-of thing for driver-tires to pipe and split.

The fact is that there is hardly a wheel turning under our freight cars when loaded to their capacity, or a driver under our locomotives, that does not strain the metal in the rail beyond its modulus of resistance. From the tests given, we can safely assume that for the majority of our rails this modulus can be taken at 45,000 lbs. In many instances it falls below 40,000. With a modulus of 45,000 lbs. the car wheel can sustain about 6,000 lbs. within the elastic limit, and this approximates to the weight on passenger equipment; hence the high service shown for the Allen steel-tired wheel.

Undoubtedly many of our older members present have seen the iron rail of 25 or 30 years ago wear down nearly ½ in. Many of them have observed, and I have measured, the wear of steel rails. When first introduced, and when lighter loads prevailed, a wear of ¼ in. was common before they found a resting place in that charnel house, the scrap-heap. Now, under present loads, their usefulness ends with from 10 to 40 or 50 million tons' service. Some one spot on our overloaded engine tires wears down ⅛ in. after a service of from 20 to 40 million tons, while the steel-tired passenger car-wheel, which is loaded to about its elastic limit, and revolves about twice as fast as the driver, gives a tonnage service of from 150 to 300 million for the same wear, nearly the whole of which wear we can reasonably attribute to the action of brake-shoes and slipping of wheels, and not to abrasion due to normal conditions of rail and wheel contact.

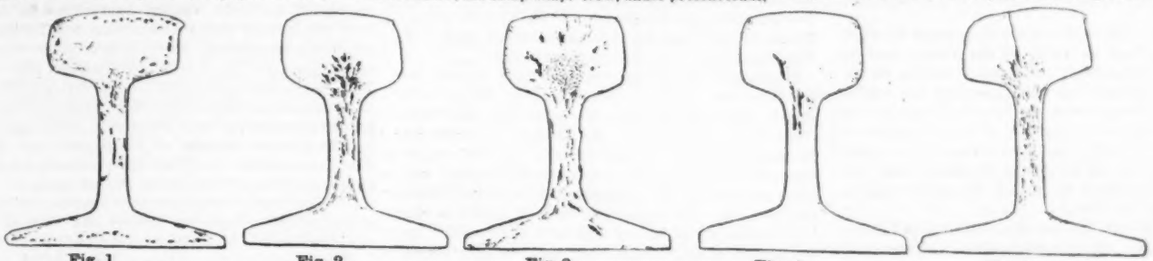
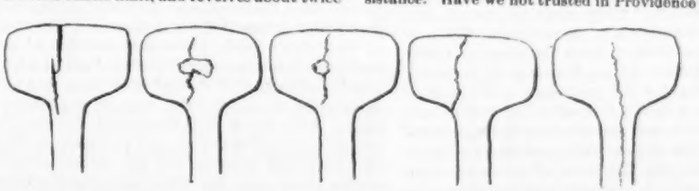


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

Sketches of Etched Rails, by GEO. GIBBS, Mech. Engr. C. M. & St. P. Ry.

Wt. lbs. per yd.	60	60	60	60	60
Carbon	.311	.42	.48	.35	.39
Manganese	.440	.92	.99	.84	1.02
Silicon	.025	.082	.055	.119	.070
Phosphorus	.113	.129	.146	.140	.149
Elongation p. c.	23.	7.	2.	17.	....
Tensile str.	83,600	88,000	80,400	97,700	....
Life in track, mos.	34	9	8	8	(short end)
Dudley's phosphorus units	28.4	41.8	53.6	58.3	51.3



Figs. 6 to 10. Sketches from Sections of Scrapped Rails Taken by DON J. WHITTEMORE.

In regard to the fillet curve of wheel-flange, it is my belief that the decision of your committee is correct—that it should not be the same as the curve of rail corner, that flange pressures should be confined, as near as possible, to the origin of the curve, where abrasion caused by increased periphery is the least, and also where leverage to resist stress is the most effective.

We would seriously consider the propriety of adding in any way whatever to the duty of the flange projection of only a trifle over 1 in., the agent between us and disaster as we rush through space at fearful velocity. I venture to say that there is not a flange on a cast-iron wheel that cannot be knocked off, without excessive effort, by a hammer in the hands of any person in this room.

To me it appers an axiom in mechanics that rolling resistance is decreased by wheels running within the elastic limit; that once wheels are of equal diameter, they will longer remain so than by the present practice, and that therefore the tendency of wheels to run to flange will not be nearly so great as now. The larger wheel always drags the smaller, when on the same axle.

It strikes the writer that heretofore the engineer of permanent way has had just enough of the æsthetic in his nature to desire to top out his work by a graceful curve, leaving the purely mechanical engineer to meet the condition it induces as best he can; and I take it as a duty of the civil engineer, *per se* the real conservator of power and matter, to meet this condition.

Looking at the rail in one end, in cross-section, we find it a very small affair, 6 to 8 sq. ins. in area, and my matter treats of but a few hundredths of this area; but when looked at in longitude, we find that it has a length of over 500,000 miles, every inch of which contains, as I believe, a blunder in design.

If this opinion is a correct one, then it is the duty of our profession to hasten the slow process of evolution, and eradicate this evil in the shortest practicable time. This cannot be done at once. Rails and wheels now in service will remain until their usefulness is past. The flat-topped rail adopted by any single line will receive the imprint of wheels worn hollow in tread by service on round-topped rails; but I believe if those responsible agents of lines forming any one of our great transcontinental routes make earnest effort in this direction, the evil will soon be practically overcome. Already an earnest effort is being made by the managers and engineers of several important corporations to secure uniformity of rail section.

It is believed that the change of form of rail contemplated in this paper will not involve the use of any more material than is now in use on many of our railways. That dear old lady, Mrs. Partington, said that when the horse ran away with her she trusted in Providence until the breeching broke, and then she—jumped. The traces of our railways are now at their fullest tension, possessing no factor of safety within the elastic resistance. Have we not trusted in Providence too long in our violation of a law of nature? Is it not our duty to be prepared to quickly leap, not into the dark, but into the light of reason, to avoid disaster that will, that does, result from present practice?

If a change is necessary, why not have our form of rail a type of that noblest of all creations, a LEVEL-HEADED man, with two legs and feet to correspond? Why not come back to the design of the American STRICKLAND of 1834, re-designed by BRUNEL in 1835, and still in use, I believe, on the Great Western Railway of England? It goes without saying that disaster surely follows any attempt to work material substances, as well as our mental faculties, beyond their elastic limit.

DIE-PRESSED STEEL TUBES, under the patents of WM. HENRY BROWNE, of Jersey City, are to be used in forming a 6-in. gun, according to a recent interview with the inventor. His process is now widely used for a number of products, such as seamless steel house-boilers, soda-water fonts, etc. A circular plate of rolled mild steel is pushed through successive dies by a hydraulic press until a tube of the required diameter and 1⅛ in. thickness is secured; the bottom is then cut off and similar tubes of longer diameter are formed about the first until a gun-barrel is the result, reinforced with shorter tubes when necessary. Mr. BROWNE claims that the process requires perfect material to start with, and detects any fault; it increases the tensile strength from 60,000 to 100,000 lbs., and it has maximum strength with minimum weight. It also has the longitudinal strength lacking in the ordinary built-up gun, and the process is comparatively cheap.

The Laws Governing the Construction and Maintenance of Country Roads in France.

[*Continued from page 140.*]

With the preceding introduction, we now will give such abstracts of French law relating to roads as would seem to have a useful bearing upon the question in this country, using in this connection the *Dictionnaire de l'Administration Française* of M. MAURICE BLOCK, Paris, 1881. As the most important in aggregate length and the money expended and force employed upon them, we will commence with the vicinal or country cross-roads of France.

Under the French law of 1836, work upon the main highways, and those of common interest in a department, is under the authority of the prefect, and the ordinary vicinal roads are in the charge of the mayors of the communes. The direct agents are inspectors, who are charged with the duty of watching this work and are responsible for its proper execution.

Inspectors.—The chief inspector, or *voyer en chef*, is under the direct authority of the prefect, and he has general charge of all the vicinal* service of the department, and all the sub-inspectors are under his orders. He executes the laws and regulations prescribed, and the inspectors of arrondissements have similar power in their own districts. The chief inspector may, when he deems fit, order that certain operations shall be carried out under agents directly under his control.

Under the law of 1836 the appointment of inspectors of all grades lay with the prefect, who might, if he so chose, transfer the control of the roads to the government corps of engineers. This right of option was taken from the prefect by the law of 1866, which included among the duties and privileges of the Council General of the department the right to designate to what parties should be confided the execution of work upon vicinal roads. The law of 1871 confirmed this right and extended it to departmental roads; so that to-day the nomination, organization, and control of the staff in charge of department roads of all classes is the exclusive right of the prefectoral authority, without restriction.

The inspectors are divided, ordinarily, into inspector-in-chief, inspectors of arrondissements, and inspectors of cantons. They shall be French citizens, and must be at least 21 years of age. The law of 1836 prescribes that in each department there shall be a commission whose duty it shall be to examine candidates for the position; and when a vacancy occurs, it is the duty of the prefect to announce the date of such examination in his department, and send this notice to the prefects of adjoining departments. The Minister of the Interior is also notified of all such vacancies and changes.

The duties of the inspectors employed on the vicinal roads are to study the projects, arrange the plans, estimate the cost, and watch the execution of all road-work, under the authority of the prefects and the mayors. Their pay is fixed by the Council General; and they are never to be remunerated by a percentage on work performed.

The Laborers.—The workmen, or *cantonniers*, for all main department highways and roads common to several communes, are appointed by the prefect. The mayors of the communes name those employed on the ordinary vicinal roads; but as this appointment implies a fixed charge upon the commune, his action must be sanctioned by a vote of the municipal council.

Days' Work by Proprietors.—France has a system of working out road taxes, but it is carried out as follows: For work of this nature two periods are generally fixed in each year, ranging from one month to six weeks in length each. The mayors of the communes fix the dates, and so arrange it that any work commenced can be finished in the specified time. And in connection with the inspector of the canton, the mayor also divides the workmen among the several roads and fixes the hours for beginning and ending work at each place. Five days before the date fixed, the mayor sends to each laborer working under this system a notice requiring him to report at a certain day and hour, upon a certain road, for such work as may be there assigned him. In case of sickness, the laborer must make this fact known to the mayor within 24 hours after receiving his notice; and while the mayor may postpone the service required, this cannot be extended beyond the current year. As an unnecessary number of workmen at any one place leads to confusion and embarrassment, it is the duty of the mayor to detail at one time and on any one piece of work, only a sufficient number of laborers to best accomplish a specified task without loss of time. If this labor is to be expended on vicinal road of common interest to several communes, the prefect of the department designates the time and location of such work.

Each *prestataire*, or workman, under this system carries to the place designated such common tools as the mayor's notice may direct. Tools with which the farmers are not ordinarily supplied are furnished by each commune from the fund appropriated to public works. All beasts of burden must be harnessed, and all vehicles must have a driver, and the time of this driver is received as a full acquittance for the time of 1 man. Farmers may substitute for themselves, or members of their family, other men hired and paid for by themselves. These substitutes must be able-bodied men, not less than 18 or more than 60 years of age.

The length of the day's work is fixed in each department by a general rule issued by the prefect, and it varies according to the seasons of the year. This day's work cannot be divided, but must be furnished entirely by the laborer. In case of legitimate interruption by reason of bad weather, the laborers are bound to complete it at the earliest date possible. If the laborer fails to report at the hour indicated, or in any way fails to complete his legal day's work, the lost time must be paid for in money. And this fine can be legally recovered by the municipal receiver of taxes.

Works carried out on vicinal roads, under the *prestation* system, are under the direction and control of the mayor of the commune in which such roads lie. This functionary is assisted by the inspector in organizing his force and commencing work, and each day's work is preceded by a roll-call, compared with the list furnished by the mayor. If any laborer breaks any of the rules fixed for the conduct of the work, comes unprovided with the tools called for in his official notice, or in any way does not conscientiously perform the duty assigned him, he can be sent from the work, and the value of his services, or the part thereof, collected in money. At the end of each day's work, the superintendent of works credits each laborer upon his official notice with the number of days and class of work done, and at the same time discharges the original requisition for labor. After the work is completed, this accredited notice is signed by the mayor, and sent by him to the municipal receiver, and the latter makes the proper entry upon his books, or register of *prestataires*.

In case a commune neglects or refuses to vote the number of days' work necessary on its roads, in the proper time for performance, and the sub-prefect advises the prefect of this fact, it shall be the duty of the latter official to serve a special notice upon the mayor of the defaulting commune demanding that he execute the required work within the specified time. This same notice also notifies the farmers that unless the work is well done in the time fixed, its value will be required from them in money. This notice must be made public by the mayor; or in case of his refusal, by a special agent of the prefect. All work of this character is done under the supervision of an inspector appointed by the prefect or sub-prefect, and the certificate of execution is delivered by the mayor on the certificate of this inspector. If the mayor refuses to do this, the certificate of the inspector himself is valid.

Task-Work by Proprietors.—Task-work has certain advantages over work by the day, for the laborers are free to select their own time, and by more active exertions they can shorten their hours of labor. When the municipal council of a commune has arranged a basis upon which it can convert days' work into task-work, and this schedule has received the approval of the prefect, the mayor of the commune may decide, as far as the smaller roads are concerned, whether work in his commune shall be done by one system or the other, as he may deem best. This decision is binding upon all the *prestataires* who have declared their intention of working out their taxes. The prefect of the department may in a similar manner decide as to the execution of work upon the main highways and roads of common interest to several communes.

When such task-work is to be done, the requisition states the class and amount of work and the date by which it must be completed. The character of work required is further indicated upon the ground by the inspector of the canton, and it is carried out under his direction. The party assigned to a task is responsible for its proper execution; and upon the receipt of the measurement and certificate of the inspector that it is properly done and within the given time, the mayor accredits the farmer with his task. Work improperly done must be done over again, and within a time fixed by the mayor.

Contract Work.—The mayors, with the authority of the prefect for vicinal roads, and the prefect for the main highways and smaller roads common to several communes, may let by contract the construction and repair of these roads. But under the law of 1836, the proprietors, even when the work is converted into tasks, cannot be credited for taxes with work done under the control and for the account of a contractor. Nevertheless, when work on any department road is let by contract, the conditions of the contract oblige the contractor to receive in return for services the day-work or tasks of the proprietors, according to a conversion tariff approved by the Council General of the department in the first case, and by the Municipal Council, with the approval of the prefect, in the second case.

In cases where the department supplies this labor in lieu of taxes from the laborer and cash paid to the contractor, the department, by its agents, makes the requisitions and superintends the execution exclusively; the contractors having nothing to do with the disposition of the men. But if the *prestataires* do not carry out their obligations, the contractors may call upon the mayor or the inspectors to compel the fulfilment of these obligations.

(TO BE CONTINUED)

*By "vicinal" is meant all roads located wholly in any one commune.

Railway Employees' Wages in Indiana.

The State Statistician of Indiana has published the following tables, showing the number of certain employés on the roads of that State and the average rate of wages paid them, as well as the work required:

	No.	Average monthly pay.	No. miles in day's run.
Passenger conductors	676	$95.88	147.59
" engineers	841	111.20	125.66
" firemen	899	59.58	125.66
" brakemen	919	51.44	147.59
" baggagemen	486	51.07	147.59
Freight conductors	1,233	78.19	103.66
" engineers	1,651	101.60	103.66
" firemen	1,706	55.15	103.66
" brakemen	2,409	51.30	103.66
			Hours daily.
Yard conductors	481	69.00	10.9
" engineers	569	79.00	11.1
" firemen	489	49.00	11.4
" brakemen	1,034	54.00	11.1
Wipers	738	36.77	10.3
Station agents not telegraphers	1,091	54.64	11.1
Station agents also telegraphers	991	43.48	11.1
Telegraphers not station agents	1,589	48.69	11

A SUSQUEHANNA BRIDGE, at Harrisburg, Pa., is projected, and it is reported that Pres. CORBIN, of the Philadelphia & Reading, has offered to take $100,000 of stock if his company is permitted to run over it. It is supposed that an attempt will be made to secure the old piers of the South Penn. R. R.

Old English Railways.

At a late meeting of the Manchester Association of Engineers, Mr. W. H. BAILEY read a paper entitled "A New Chapter in the History of the Manchester & Liverpool Railway," in which occur some interesting data relating to the efforts of Mr. WM. ROSCOE to drain and improve portions of the famous Chat Moss.

Mr. ROSCOE, the poet, philanthropist, and banker, engaged Mr. ROBERT STANNARD as his steward in this work; and about 1816 he introduced a railway designed by Mr. STANNARD. The rails were of wrought-iron, in the shape of an inverted *V*, with projecting flanges for bolting to cross-ties. The wheels on the car were also *V*-shaped, made to fit the rail.

In 1823, when the survey for the new railway to Liverpool was commenced, STANNARD claimed that

Mr. STEPHENSON saw the work done in the Moss and the wagons and tramways at work, and from the end there accomplished he was induced to go straight across the marsh instead of around it. STEPHENSON gave STANNARD the sub-contract from Eccles over the Moss. The enormous difficulties attending this work have been graphically told by Mr. SMILES and others, but Mr. BAILEY here first tells of STANNARD'S connection with it, as follows:

The first difficulty in not finding a bottom of Chat Moss was at a place called Blackpool Hole. Here the contractor tipped spoil for more than 3 months without making the slightest progress. Quantities of old sugar casks were chained together with brushwood and moss, but these came to the surface again at some distance from the side of the line. Altogether something like 7,000 cu. yds. of spoil were tipped and disappeared at this place. At length the directors began to complain, and STANNARD urged them to purchase a plantation of young larch trees about half-grown, nearly a mile distant from the line, at a place then and still called Botany Bay Woods, near to Worsley Hall. Part of the wood was bought, the trees grubbed up by the roots, and dragged to the Moss. These trees were laid together 'herring-bone' fashion; pieces of rock, spoil, earth, and loose material were then tipped upon this timber, and the desired effect was obtained. No further difficulties were then encountered, the remaining portion of the work being done by the ordinary side drainage and copping. The whole of the cost of the 4 miles was not £37,000, which was considered a large sum in those days, but which would not be thought very costly at the present time. The directors allowed STANNARD a penny per cubic yard extra for the expenses in the purchase of the plantation of Botany Bay Wood.

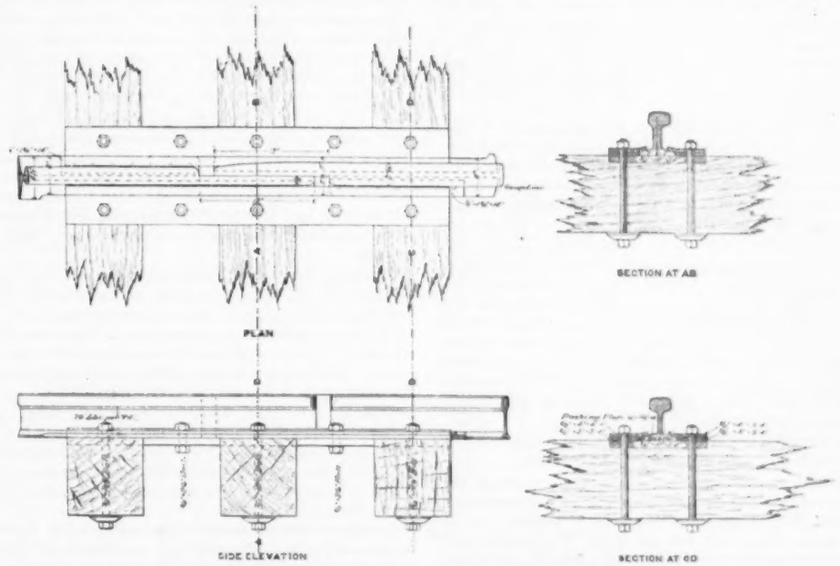
During the controversy between Stannard and Stephenson it seems there was great difficulty in convincing Stephenson that the raft system was the best, as Stephenson always insisted that if they put spoil enough on the Moss, it would find a bottom; and although it did no doubt sometimes reach the bottom, it did not stay there. But after many anxious discussions Stephenson said to Stannard, "Have your own way." The contractor replied, "Yes, I will; but I want some money." Stephenson then said, "The directors have none; but I have £400 in one of the Liverpool banks of my own, and I will lend it to you." He got the money, and, with a fresh supply of wagons obtained from Manchester and the weft and warp of the trees of Botany Bay Wood, he became successful in obtaining a foundation.

American Well-Borers Abroad.

In this country well-boring has been made quite a speciality since the discovery of oil opened up a field for that industry, and the work of sinking wells for oil, natural gas, and water has been more extensively carried on here than in any other part of the world, while American contractors have brought this work to such a high degree of perfection that they are being engaged to carry out large contracts for such work in foreign countries. Mr. DANIEL DULL, of this city, one of the leading contractors for well sinking, recently sent out complete sets of plant to the diamond fields of Kimberley, in South Africa, where it is intended to bore for oil; water will also be sought for probably, as a good supply of water is very desirable in that region. The same contractor has also been selected to carry out work for a Scotch syndicate which has been organized to develop the old oil fields in British Burmah, India, and several complete outfits, with gangs of experienced men, have been sent out to Rangoon, whence they will proceed up the Irrawaddy river. These celebrated oil fields have been worked in a primitive way for centuries. There are about 900 wells on an area of about 16 square miles; and the oil which bubbles up at the bottom is raised by buckets and kept in earthen pots, the making of which keeps a large number of potters employed. The wells are in beds of sandy clays which rest on sandstones and argillaceous slate, below which coal strata are believed to exist. Mr. DULL has had considerable experience with well work since the early days of development of the oil fields of Pennsylvania, and is now sinking a well on Blackwell's Island for this city. He also put down the great well at the Ponce de Leon hotel, St. Augustine, Fla.; it is 1,400 ft. deep and 12 ins. diameter; the water rises to a height of 20 ft. above the ground, forming a large fountain, and the flow is estimated at 10,000,000 galls. per day. The strata were mostly soft and the work was done in two months. He is also making propositions for a large enterprise in South America. Sometimes wells are put down which prove failures, but the failures are generally due to the inexperience of the contractors in using too small a bore for great depths, and well boring like other work, requires to be carried on in a proper manner with regard to certain natural laws, and not by the mere boring of a hole at haphazard.

Adjustment Panel Rail Joint, Poughkeepsie Bridge.

The accompanying cut shows a detail which often causes some trouble in design, and which has proved so far by experience on the bridge to be about right, but which requires little description beyond the cut itself. The track over the bridge is laid with the Fisher bridge joints, and the expansion joint comes as nearly as possible to that type of joint while providing for several inches of expansion, which is liable to occur from change of length of the trusses. A heavy base plate and upper packing plates provided a trough in which the two ends of the rail slide, the rails being "halved" (but not exactly halved) for a length of 12 ins. and not otherwise connected. Neither rail has the neck cut at all. On the gauge side of the rail, the line is made perfect by planing off the inside of the head by an amount equal to the thickness of the web, the rail being slightly bent beyond the joint so as to enable this to be done. The right rail is left of its natural thickness. On the outside of one rail and the inside of the other, ¼ in. is planed off, so as to make the rails enter truly in the joint, although their necks are nearly an inch (15-16 in.) out of line. The axis of the joint is therefore ¼-in. in from the axis of the rails on each side of the joint. The full head of the rail is 2 13-16 ins. The thin end of the left rail is 15 16 in. All the sharp ends are carefully rounded, but we are disposed to question the expediency of the long outside taper of the right rail, and should prefer instead to bend down the top, leaving the width full. A "double-flange" would then not be able under any conditions to crowd a wheel over and cause derailment, a thing which frequently happens with all kinds of horizontal bevels such as that in the cut. The rounding on the gauge side, however, is highly desirable.



Adjustment Panel Rail Joint, Poughkeepsie Bridge.

Report on the Syracuse, N.Y., Water Supply.

This exhaustive and excellent report of Mr. J. J. R. CROES, M. Am. Soc. C. E., bears date of Feb. 1, and was issued in connection with a report of a commission appointed to inquire into and investigate the sources of water supply for Syracuse, New York.

The investigations of Mr. CROES cover 12 possible sources examined and reported upon in detail. The basis of capacity of the required supply is assumed on a present population of 90,000, and its likely growth within the next 50 years, and a daily consumption of not less than 80 galls. of water per head. On this basis the source of supply would have to yield 37,000,000 galls. a day, with works giving, as built, 15,000,000 galls. daily. In the vicinity of Syracuse the amount of water which can be depended upon, from a stream or lake, is about 600,000 galls. daily per square mile of water-shed, providing that storage for at least 120 days' supply can be obtained. This requires that any source of supply considered should possess at least 60 sq. miles of tributary water-shed and a storage of at least 4,500,000,000 galls., and the storage reservoirs first built should have a capacity of about 1,800,000,000 galls.

The sources examined included Lake Ontario, Lakes Skaneateles, Cazenovia, Oneida, Otisco, and the Tully Lakes, the Salmon and Seneca rivers, Onondaga creek—a ground water supply obtained by driven wells from the valley of Onondaga creek—and the existing works of the Syracuse Water Co. While each of these sources is carefully studied and reported upon, only 4 are recommended in the report viz., Lake Skaneateles, Onondaga creek at Cardiff, Salmon river, and Oneida Lake. Of these the Salmon river water-shed includes 70 sq. miles of forest land, from 1,000 to 1,500 ft. above sea-level, about 40 miles northeast of Syracuse. It has a favorable site for a storage reservoir of the required capacity, where a 32-ft. dam will give a water-surface 590 ft. above the city. This storage reservoir would be 42.72 miles from the distributing reservoir. The entire cost of supply from this source is estimated at $3,879,719.

Lake Skaneateles is 16 miles from Syracuse, and is generally 15 miles long by about 1 mile wide, with an area of 12¾ sq. miles. It has a water-shed of 70.25 sq. miles, with about 600 dwellings in all upon it. The lake is very deep, and the shores are bold and free from vegetable growth. The State of New York has the right to use for the Jordan Level of the Erie Canal a supply of water reported at 8.776 cu. ft. per minute during the period of navigation, an average of about 225 days in the year. This water does not belong to the State, but to mills on the stream leading from the lake to the canal; and it would probably be possible for the city to condemn the mill privileges and acquire the right to the water for the period when the canal is closed. The plan proposed for a supply includes a 30-in. pipe laid 1,000 ft. into the lake, leading to a distributing reservoir at an elevation of 230 ft., and a stand pipe 100 ft. high. The cost is estimated at $3,212,093.

The Onondaga supply would be taken from a point 10 miles from Syracuse, where a deep gorge affords a favorable site for an impounding reservoir, with a tributary water-shed of about 40 sq. miles. A dam, 52 ft. high, would store 4,340,000,000 galls; but as it would only have an elevation of 120 ft., the water would have to be first led to a convenient point and then pumped, and used in connection with a stand-pipe, for high service. The estimated total cost is $3,219,600.

The Oneida Lake is 15 miles northeast of Syracuse; it is 20 miles long and has a general width of 4¼ miles. The deepest water is 60 ft.; but it is generally shallower, with an average of about 20 ft., and as the rise and fall is 10 ft., large areas of shore are exposed at low water. There are about 100,000 inhabitants on its water-shed of 1,327 sq. miles. The lake surface is 30 ft. below the level of the canal at Syracuse, and the water would have to be pumped about 15 miles in a 36-in. pipe to reservoir 250 ft. above the canal; including friction, this would be equivalent to a pumping lift of 400 ft. The estimated total cost is $3,692,790.

In connection with the ground-water supply from the valley of the Onondaga creek, Mr. CROES reports as follows: In 1887 the Syracuse Water Co. sunk 8 tube wells in a plateau about 17 ft. above the canal level at Syracuse, as an experiment. These wells were sunk to a gravel stratum saturated with water, and a steam pump attached to the wells and run for 82 days, pumped part of the time at the rate of 3,168,000 galls. daily, without apparently affecting the level of the ground-water in the vicinity. The water was very free from organic impurities, but very hard, according to analyses by Professors CHANDLER and LATTIMORE.

In September, 1888, the company made a more elaborate test by putting in 32 tube-wells, 24 of 6-in. and 8 of 4½-in. pipe. These wells were 50 ft. apart and sunk 40 feet. The 6-in. pipes were connected to 2 collecting mains 600 ft. long, meeting at right angles, and at the point of juncture centrifugal pumps were placed, driven by steam. The 4½-in. pipes were connected to a main 400 ft. long leading to another pump. A number of test-tubes were sunk in the vicinity to observe the effect of the pumping on the level of the ground-water. According to tests of the strata made by Mr. CROES, after passing the top soil, there were found about 10 ft. of loose gravel and clay, free from water; then 6 ft. of hard-pan, impervious to water; then about 22 ft. of water-worn shaly gravel, saturated with water under a considerable head, the water rising in the tubes 7 or 8 ft. above the bottom of the hard pan stratum.

Pumping was commenced on Sept. 4, with the water in the test-tubes standing 8.5 ft. above the canal in Syracuse, and the surface sloping to the south at the rate of 3 ft. per mile. The pumps were run continually until Oct. 5, pumping, as estimated by the owner, 250,000,000 galls., or at the rate of 8,000,000 galls. daily. The measurement of flow made under the direction of Mr. CROES did not sustain this claim, however, and he estimated that it never exceeded 7,000,000 galls., and was generally not over 6,000,000 galls. At the end of this 31-day test the surface of the ground-water was bowl-shaped; being 6 ft. below the original surface at the center of the wells, and 4 ft. below at the circumference of a circle 1,500 ft. in diameter. The pumps were stopped for 24 hours, and the water rose in this bowl about 3 ft. in the middle, 15 ins. at the up-stream edge, and 8 ins. at the down-stream side.

Pumping was resumed on Oct. 6, and continued until Nov. 4, with three stoppages aggregating 66 hours to one of the pumps; the other pumps being run at increased speed during the stoppages. The result was about the same as before. And 60 days pumping had therefore lowered the ground-water an average of 4½ ft. over the area of a circle one mile in diameter. From the slope of the underground water surface, the area effected by this pumping must have extended at least 4 miles up and down the valley.

After the pumping had stopped, it took 45 days for the natural flow of the underground stream to fill up the basin created by the pumping to the original level. This was, too, in the season when the ground was saturated with the heavy rains of September, October, and November; and the underground flow was above the average, as was shown by the fact that from Dec. 14 to Dec. 29, the water in the test-tubes rose 5 ft. above the level before pumping in September. Mr. CROES concludes, from these indications, that the water-shed is not extensive, that the flow is very variable and seriously affected by a dry season, and that when it exceeds the summer flow, the main body of water is discharged by springs about 3 miles north of the wells. The existence of a rock barrier across the valley at Cardiff, as proven by the borings, shows that it is probable, says Mr. CROES, that the source of supply is neither deep-seated nor extensive. While all agree upon the organic purity of the water, it is very hard, due largely to sulphates of lime; and when the underground water was disturbed by pumping, the new water, which came from the upper part of the valley, was harder still, and more charged with sulphates, probably from beds of gypsum.

Mr. CROES being instructed to also report upon the relative desirability of having water-works owned and controlled by the city or by a private corporation, gives his views at considerable length. He says that of the 50 large cities of the United States, having a population exceeding 50,000, only 9 are supplied by private corporations. And of the cities larger than Syracuse, only 5 are supplied, namely: San Francisco, New Orleans, Indianapolis, New Haven, and Kansas City.

Mr. CROES says that the statistics of water-works in this country seem to show that towns with a public water-supply use more water than those supplied by private companies. Thus Cleveland, O., with a public supply, in 1886, had 18,411 taps, while New Orleans, with a greater population, had but 4,400 taps; Allegheny had 12,937 taps, while Indianapolis, with about the same population, had 1,679. Worcester, Mass., had 7,191 taps, and Kansas City, with same population, had 6,080 taps; Springfield, Mass., with a public supply, had 4,237 taps, and Utica, N. Y., with a private supply, had but 1,800 taps; Trenton, N. J., with a public supply, had 6,046 taps, while Elizabeth, with about the same population and a private supply, had 3,000 taps; and this proportion seems to run through the whole list of towns with a water supply.

The part of the report relating to the relative cost of water to the consumer, from public and private sources, is based partly upon assumption, as the statistics of private companies are difficult to obtain and the basis of rates differs widely in different towns. Assuming a house of 20 to 25 ft. front, value $2,000 to $3,000, 3 stories high, having 10 rooms occupied by 7 persons, and having 1 bath-room, 2 water-closets, 4 wash-stands, 3 taps, and 6 extra faucets, Mr. CROES finds that in 129 towns, with a public supply, the average rate is $18.20 per year; while in 123 towns supplied by private companies, the average annual rate is $25.

Taking a town of 90,000 inhabitants, with 9,000 water-takers, the difference to consumers at the above rates would be $61,200. In such a town there would be about 700 fire hydrants, and the average annual rent paid to private companies for such fire-hydrants is $45 as near as can be ascertained. This sum is paid out of taxation, and in the town taken for comparison, the sum paid to the private company would be $256,500 per annum, including in this the water-rent. The annual cost of maintenance of a gravity supply of this size would be $30,000 per annum, and for a pumping supply, $75,000, or an average of $50,000 for all towns. Consequently, with a public supply, the people would pay $163,800 for water rent and $50,000 for maintenance, a total of $213,800, or about 17 per cent. less than would be paid to the company. But as the interest on the construction account should be added to the yearly account, there is probably not much difference to the consumer in cost; and the main objection lies in the decreased number of consumers, as shown before.

A Ship Canal Across Scotland.

The proposal to improve the present existing canal between the Clyde and the Forth, so that ships might be able to pass through, is described by *Engineering* in substance as follows: An old canal already exists, constructed a century ago, and is 35 miles long, extending from Bowling on the Clyde to Grangemouth on the Forth, the line being almost due east and west, and there is a branch of 2¾ miles to Port Dundas in the north of Glasgow. It rises 156 ft. and has 39 locks. At the present time only very small craft can be passed through, not only because of the short locks, but also owing to the depth of water being but about 9 ft. It is proposed that it should be made suitable for deep sea-going ships.

There are no great engineering difficulties in the way. The cost is estimated at between $7,500,000 and $10,000,000, a sum which, it is thought, might be easily raised by a company. It is contended that, being the shortest route between America and the Baltic, the Continent and the east coast of Scotland and England, the through traffic would be considerable; but the gain in time would be reduced materially by the fact that vessels in coming off the Atlantic would require to sail up the long Firth of Clyde, and would probably require, particularly if deeply laden, to wait on the tide to get up the river, or the channel would need to be broadened and deepened, thus adding to the cost. For channel steamers going from Ireland or the west coast of Scotland, England, or Wales, to the east coast or the Continent, the canal would be a decided benefit; for not only would their voyage be shortened, but the rocky and dangerous coast of the north of Scotland would be avoided. The canal passes through the coal and oil districts of Scotland, a fact which affords additional arguments in favor of the scheme. Another consideration which carries much weight is the facility gained for the rapid passage of battle ships from one shore to the other, rendering defense in time of war more effective. The canal is the property of the Caledonian Railway Co., and they are taking no action, meantime, in the matter.

Portable Rail Saws.

Portable rail saws, for cutting rails while in the track or on the ground, are an improvement on the old method of cutting rails with hammer and chisel, and an efficient tool of this kind is a valuable addition to the track equipment of railways, especially for use in yards where rails have to be cut to fit different arrangements of frogs and switches. We illustrate two forms of this tool which are now on the market.

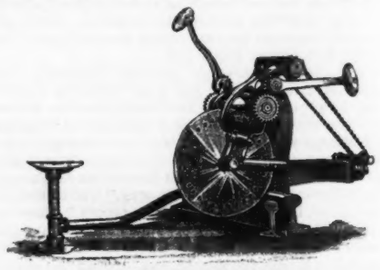


Fig. 1. The Higley Rail Saw.

The "Higley" rail saw (Fig. 1) is a circular saw worked by one man who sits on a seat, which, by his weight, forms a brace for the machine. The power is transmitted by gearing to a wheel with projections which engage in holes near the rim of the saw. An oil cup lubricates the cutting edge, and the feed is worked by a nut driven by a chain belt; a fine or coarse feed can be put in gear at will. A drill for making the fish-bolt holes is also fitted to the machine. It makes a fine, smooth cut, and has cut a 50-lb. rail in 14 minutes. The saw is guaranteed for 500 cuts, and will take off a section ⅛-in. thick. The machine complete weighs about 85 lbs., and its price is $100. It is manufactured by the Higley Sawing & Drilling Machine Co. of this city.

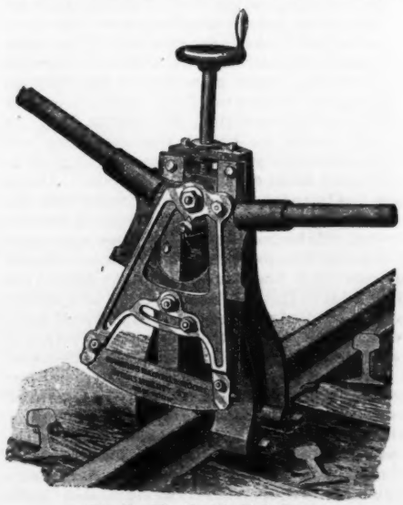


Fig. 2. The Smith Rail Saw.

The "Smith" rail saw (Fig. 2) is a swing saw and is worked by 2 men at the handles. The feed is automatic; soapsuds are used for lubricating the cutting edge. This saw will also take off a piece ⅛ in. thick, and the time for cutting off a 70-lb. rail is stated at from 15 to 20 minutes, including the setting of the machine in position. The weight of the machine is 175 lbs. and its price, including 10 saws, is $200; extra saws cost 50 cts. each. This tool is in use on a large number of roads, and the makers have several commendatory testimonials. It is supplied by the Smith Portable Rail Saw Co., and Manning Maxwell & Moore, of this city, are the sole agents.

The Trincheras Incline, Venezuela.*

In this paper a comparison was instituted between two different methods of setting out railways in mountainous countries, namely, that of adopting as nearly as possible a uniform gradient, in order to surmount a high summit or that of keeping the line as long as possible in the valley, and overcoming the ascent by steep inclines. The interior of Venezuela, the auther explained, was cut off from the Caribbean Sea by a range of mountains, now crossed by two lines of railway, one of which, the line under discussion, was 34 miles in length with a summit level of 1,950 ft. It connected Valencia, the capital of the State of Carobobo and the second city of the Republic, with the harbor of Puerto Cabello. The principle adopted in setting out this line by the engineer, General J. C. DE CASTRO, was that of making the gradient uniform from the sea level at Puerto Cabello to the summit.

The author was invited by the President of the Republic to report upon the line thus traced out; and, on his recommendation, further studies were undertaken, including a survey for a new line, adopting the principle of getting down from the summit as quickly as possible by a steep incline and then following the valley bed. Of the two sets of surveys made, one was with gradient of 1 in 20, with the view of using ordinary locomotives, and the other with a gradient of 1 in 12½, on which some special mode of traction would be necessary. The latter line was adopted on the recommendation of the author, and the railway had been constructed upon it. The rack system, as improved by Mr. ABT, was adopted for working the incline. In this the rack consisted of 3 parallel plates, 1 9-16-in. apart, bolted firmly together; each plate was a complete rack, and they were laid breaking joint both as to the ends of the plates, which were all of the same length, and also as to the position of the teeth. The two pinion wheels on the engines, which worked into the rack, were formed each of 3 tooth rings, one for each rack bar. They were laid together with the teeth of one ring leading those of the next by the amount of stepping or overlap in the teeth of the rack. The rings had an elastic connection with the shaft, to correct inaccuracies due to imperfect workmanship, or to the expansion and contraction of the rack-rails; and in practice no jar was felt, even when the engine was running at 15 miles per hour.

Plans and sections between Puerto Cabello and La Entrada, of the original line with uniform gradient, and of the line as constructed with an inclined plane, were given. For brevity the former was called the "Guaiguaza" line, and that with the inclined plane the "Palito" line. In making the comparison regard was paid to: 1. Original cost. 2. Maintenance of way and works. 3. Locomotive expenses. It was shown that the Guaiguaza line would have been much more costly than the other. The country through which that line passed was extremely rough, the general slope of the hills being not flatter than 2 to 1. The cuttings and embankments would have been seldom less than 30 ft. or 40 ft., and often 100 ft. on the center line. Many viaducts and heavy retaining walls would have been necessary, and the cost of the railway would have been more than double that of the Palito route. It was known from experience gained on another line through a similar country, subject to the same climate, that the Guaiguaza route would have been liable to constant landslips, and might have been blocked several times every rainy season; but on the Palito route the danger of slips was almost entirely removed; for, owing to the formation level being close to the bottom of the valley, the line was kept further out from the hillsides than would be possible where, owing to the steepness of the latter, the toe of an embankment would have found no support until it reached the valley bed. There was a further advantage in this case, that the rocks were more solid in the lower levels, changing in the section between Trincheras and Castano into hard granite, and not, therefore, liable to slips of any moment. On the Palito route, the curves obtainable at an expense within the resources of the railway were much better. This tended to economy in the maintenance of way and works. Taking all these matters into account, the author came to the conclusion that the Palito route was as much the better of the two lines in regard to maintenance of way and works as in first cost.

The author then proceeded to show that the Palito line was somewhat superior in respect of locomotive expenses and was capable of handling a greater traffic than the other with the same engine power, and of carrying passengers safely and economically at a higher average rate of speed; by means of a time-table for each line, he showed what could be done with 4 engines in steam, working steadily for the whole day, without shunting work at the terminal stations. The length of the 2 lines was the same within 100 ft. It was shown that on the Guaiguaza route a traffic of 90,000 tons a year each way, and on the Palito route one of 108,000 tons, could be carried. The number of engine miles daily would be, for the Guaiguaza route 408, and for the Palito 350. The time occupied between terminals for passengers would be 2¾ hours for the Palito and 2¾ hours for the Guaiguaza. By adopting the Palito route, therefore, the carrying capacity was increased 20 per cent., the engine mileage reduced 14 per cent., and the speed increased 17 per cent.

For working the up traffic, an engine left Puerto Cabello in the morning with a full load, generally 12 wagons, for Cambur. Eight wagons were left at Cambur, and 4 taken up the bank to Trincheras, where they were placed in front of the rack engine, and taken by it up the incline to the summit at La Entrada. The engine, as it had placed the wagons in front of the rack engine, returned to Cambur, and brought up another set of 4, placing them again in front of the rack engine, which had by that time come back down the incline. This process was continued until the whole train with which the engine left the port in the morning was taken to the summit, when the engine returned to the port, having done its day's work by running 102 miles, and having been 7⅛ hours in steam. The several return trips of the ordinary and of the rack engines were not made light, as the latter brought down from the summit to Trincheras, and the former from Trincheras to the port, the down goods which a third engine had brought from Valencia. The remaining traffic of the day was worked in the same manner, the wagons being taken up as in the other case in several trips from Cambur to the summit, and thence into Valencia by the Valencia engine.

The author then proceeded to show in what respects the engines used by Mr. ABT on the Harts Railway, and elsewhere, differed from those adopted for the Trincheras incline, in that the latter dispensed with adhesion altogether, working only through the rack. The 2 pinion wheels in the Trincheras engines were each actuated by a separate pair of cylinders, and both pinions press fully against the teeth of the rack, notwithstanding any slight irregularities in the latter. There were 2 cylinders on each side of the engine, one above the other, so arranged that the same steam chest, slide valve, and valve motion served for both. The 2 lower cylinders actuated the leading, and the 2 upper the trailing, pinion wheel. There were 3 independent brakes on the engine. The principal details and dimensions of the engines were then given. In working, the engine always pushed the load up the incline. The gradient of the incline was 1 in 12½ for a distance of 7,700 ft., and from 1 in 28 to 1 in 21 for the remaining 4,000 ft., the total length of the incline being about 2¼ miles. The minimum radius of curvature, 500 ft., occurred on the steepest part of the gradient. All the stock was furnished with the Heberlein brake, and the trains were completely under the driver's control. The only structures of importance on the incline were 4 viaducts. The author's object in this paper was to draw the attention of engineers to the advantages, not in his opinion adequately recognized, of the system of using steep inclines instead of long gradients.

On the Puerto Cabello line, the incline led to no saving of distance, and the cost of locomotive working was not much reduced; but in the majority of cases, where an incline could advantageously be used at all, it would save a long development of line, with consequent economy. The Trincheras gorge, although rough and with very steep side slopes, was unusually straight, and the author was at first inclined to advocate the system of rope traction; but he found that the local authorities would not approve of the system, and he did not, therefore, prepare any plans for rope traction, but recommended the Government to specify the Fell system, which was done. When, however, the company was formed for constructing the line, the consulting engineers, Messrs. JAMES LIVESEY & SON, decided to use the Abt system of rack.

In the author's opinion, the change was an improvement, experience of both systems having convinced him that the improved rack was better than the Fell center rail, where the curves were moderately good, especially where engines independent of ordinary adhesion could be used, and where the complication of coupled pinions could be got rid of. On the Trincheras incline, with curves of not less than 500 ft. radius, the pinions worked with practical accuracy into the rack. The mechanical drawbacks of the 2 systems might be thus summarized: in the Fell system there was increased journal friction, due to the pressure in keeping the gripping wheels in adhesion with the center rail; in the rack, friction was due to the imperfect adaptation of the pinion to the rack. The one was independent of the curvature of the road, while the other increased rapidly with it; and there was, therefore, some radius of curves at which the two systems would be equally favorable, an increase of the radius tending to give the superiority to the rack, while a decrease would tend to give it to the Fell. The Trincheras incline was opened for public traffic in March, 1888, and had been working ever since without accident or difficulty.

*Read by Mr. JOHN CARRUTHERS, before the Institution of Civil Engineers, Jan. 29. Abstracted in *Engineering*, Feb. 1.

New Baltimore & Ohio Train Shed at Pittsburg.*

We present herewith a plan and elevation of this important new structure. The designs and plans of the depot at the end of the train shed are not yet available for publication. The following details as to the train-shed, we abstract from a paper by J. E. GREINER, C. E., read before the Engineers' Society of Western Pennsylvania. The depot is to be opened March 3 for passenger traffic, but may not then be quite completed in all parts:

The floor of the shed will begin at the abutments built on the east side of Grant St., and making an angle of 75° 40' with these abutments extends along the wharf for a distance of 422 ft., until it meets and is connected with the depot near Smithfield St. The floor system is supported by 32 pedestal posts, there being 3 lines spaced 42 ft. centers laterally and 38.5 ft. longitudinally varying in height from 8 ft., 8 ins. to 30 ft., 10 ins., according to the slope of the wharf. The section is made up of 15-in. plates and 3½ x 4 angles strapped together by heavy lattice bars. These posts have enlarged bases, 40x40 ins. for the center line and 32½x32½ ins. for outer lines, thereby making the maximum pressure that can ever bear on masonry 300 lbs. per sq. in.

They are anchored down by four bolts 1¼ ins diameter, are connected together in pairs by stiff longitudinal struts placed near the top, and by knee braces securely connecting them to the cross girders. There will be a clear head-room under the entire structure of 12 ft. 9 ins., and the passage to and from the water impeded as little as possible.

There will be 22 floor beams or cross girders resting directly upon the top of pedestal posts, being secured by 4⅞-in. rivets at each end. The length is 42 ft.; depth, 5 ft., subjected to a flange strain of 406,900 lbs. and requiring 50.86 sq. ins. of metal in one flange alone. The cross girders being thus securely fastened to the posts, the expansion and contraction due to changes in temperature will merely deflect the pedestal posts a little beyond the plumb line.

There will be very little change in length, however since the iron work is protected by a wooden floor, thus keeping out the rays of the sun, and it is probable that, with the extremes of temperature, the length of the 42-ft. girders will not vary more than ¾-in. There is one point, however, where an expansion joint was considered desirable, and that is at top of post marked *C* in plan. It will be seen that one end of cross girder *B C* rests on the masonry, the other on post *C*, and the floor beam being firmly anchored to the masonry, the slip joint was made where the two cross girders abut. The girder *B C* is lighter than the others, and is but 4 ft 2 ins. deep. The joint is shown on the detail sheet.

There are four tracks to be supported, consequently 8 lines of main stringers or longitudinal girders 38 ft. 6 ins. long and 4 ft. deep, which are riveted directly to webs of cross girders. In addition to these track stringers, there will be four lines of girders for carrying the passenger platform. Provision for expansion has been made in a very simple and common way, viz., at expansion end the weight is supported entirely by a bracket or shelf riveted to cross girders, while the end of the stringer, thickened by reinforce plates, so as to have ample shearing area, passes between the projecting legs of two angles riveted to cross girders. The girders are held in place by two bolts, ⅞-in. diameter, passing through finished round holes in the angle legs and through 2x1 in. slotted holes in web of girder. Thus, while holding the stringers firmly laterally and vertically, there is at the same time freedom for longitudinal motion.

The floor or platform will be on the same level as top of rail throughout the entire shed, thereby facilitating the passage of trucks across from track to track; 2¾ in. white oak planking will be used, laid lengthwise or parallel with the tracks, and supported by 12 x 2 in. joists under passenger platform and by ties under rails. All that portion of the floor which lies between the end of the shed and the west abutment will be made of 3 ft. x 3 ft. x ¾ in. buckle plates filled in with granolithic or some similar material, which will make a good and permanent roadbed. In order to hide or cover the ends of the I-beams which support these buckle plates a cast-iron moulding, conforming in shape to the coping of abutment, will be connected to them and extend from the stone coping to the first post supporting the

*A paper read before the Engineers' Society of Western Pennsylvania, by J. E. GREINER, C. E.

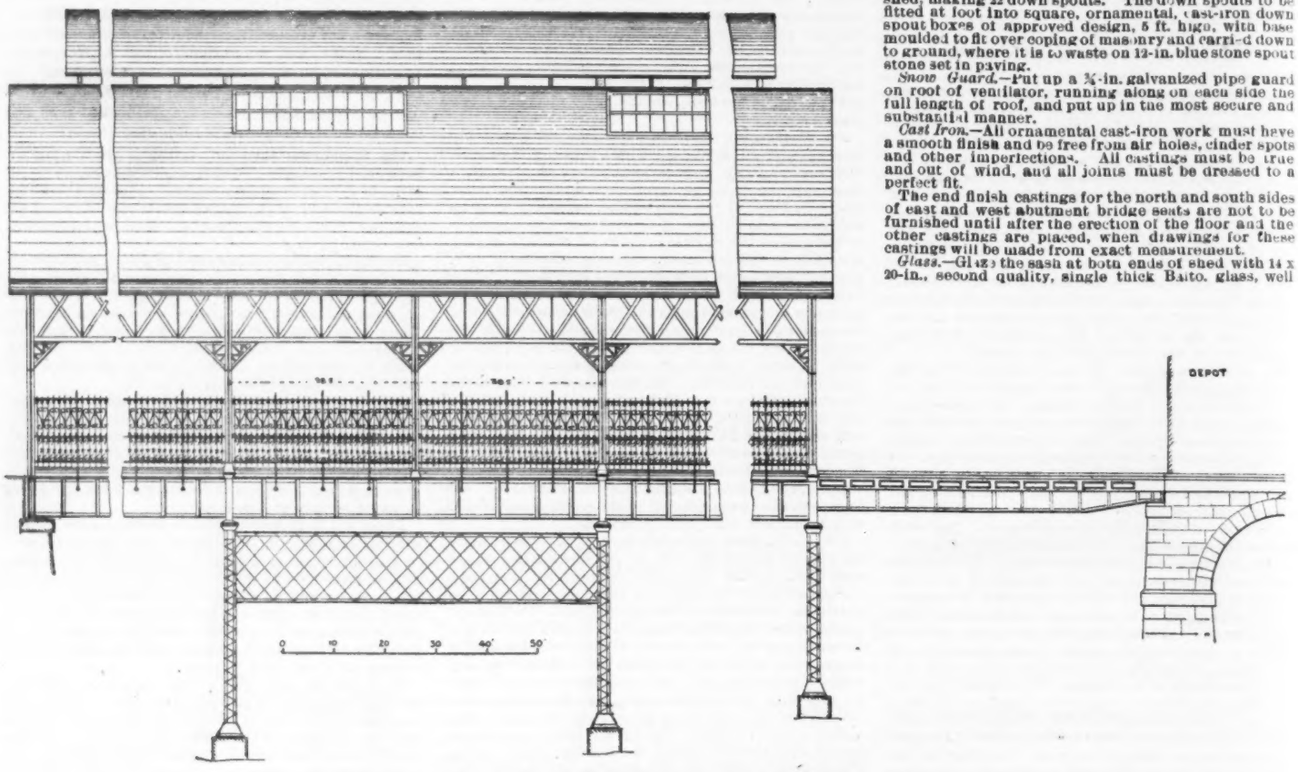
roof. From this post, throughout the entire length, a moulding of wood and of neat design will cover the ends of floor joists. The railing extending along the sides of shed will be entirely of wrought-iron and quite ornamental in design. All these details are shown on the engravings.

The shed will begin at Grant St. abutment, extend a distance of 385 ft., or to within 32 ft. of the east wall of station. It is composed of 19 intermediate trusses—span, 84 ft.; rise, 21 ft.—and two end trusses of same span and rise, making in all 21 trusses, supported upon 42 posts of]|[section, 4 angles and a plate, about 22 ft. high, resting on top of cross girders at their ends and on top of the outside longitudinal girders at their middle. The end trusses were made with vertical compression members in order to give better facilities for glazing and boarding in the gable. The end truss at the east end is also stiffened to resist any wind which might blow against its covered gable. Trusses are connected to top of each post by four ¾-in. bolts, all lateral expansion being taken up by the flexibility of the posts, or, in case these prove too rigid, the truss itself will simply rise or fall a little, as the case may be. A good strong bracket of wrought-iron adds lateral stability by firmly uniting the main rafters with the posts, whilst longitudinally all the posts are connected by trussing and brackets, as shown on drawings. The main rafters will be of seasoned long leaf yellow pine; all other truss members of wrought-iron.

Between the main train shed and the east wall of station there will be a wooden truss with rafters running perpendicular to those of the shed, or, in other words, the gable end of this part of the structure will face Water St. The tracks, of course, will extend no further than the end of main shed, where a line of gates will prevent the passengers passing to the train until the proper time.

The total weight of iron in the structure is divided up as follows:

	Pounds.
Pedestal posts	115,100
Cross girders	404,200
Longitudinal girders	841,100
Upper posts	56,900
Trusses	82,400
Braces and brackets	113,500
Cast-iron	14,300
Miscellaneous	81,100
	1,708,500



New Baltimore & Ohio Train Shed at Pittsburg. Elevation.

The following extracts from the specifications for the train shed will be of interest.

Lumber.—All lumber to be of the best quality of the respective kinds herein mentioned, perfectly seasoned, sound and free from all large or injurious knots, sap, shakes, or waney edges or other defects, and to be of full dimensions.

Georgia Yellow Pine.—All roof and truss timbers, rafters, purlins, etc., to have ornamental sawed ends; purlins to be notched down 1 in. on trusses, 1¾ in. t. g. and beaded; sheathing not over 3 ins. wide, laid at an angle of 45° to rafters on that part of roof inside of barge boards, reversing the slues; that part outside of barge boards and the ventilator to be laid with sheathing at right angles to rafters, ⅞ in. t. g. and beaded; siding at ends where indicated to be beaded on both sides when both faces are exposed.

White Pine.—All barge boards, sash pieces, mouldings, beads, curbs, for skylights, ventilators and casing of ventilator posts, moulding and facia piece to enclose ends of joists.

White Oak.—2½ x 8 in. thicknessed flooring with butt joints tightly wedged up and thoroughly spiked to joint; 2-in. x 12 in. joists, 3 ft. c. to c., notched on to stringers and furred up, as shown, to receive flooring between rails. Floor boards to be kept 1¾ ins. clear of both sides of rail, and to have edge towards rail chamfered.

Skylights.—Put up Vaile & Young's (Balto.) patent skylight, with beveled bar and ¼ in. ribbed glass, where shown. The contractor to do all flashing, etc., around skylight with same tin as below. All to be put up in perfect manner and guaranteed against leaking.

Felt.—All tin to be laid on O. K. straw building paper. (H. W. Webb & Sons, Balto.)

Tin Work.—Cover all the roofs and do all the flashing and counter flashing, wherever necessary, and line all gutters, which must be properly graded to down spouts with Gilbertson Old Method (Merchant & Co., Phila.) charcoal-leaded I C tin, each sheet to be stamped with brand and thickness—14 x 20 ins. for roofing—laid with 20-in. way down the roof; to have two cleats to each sheet and two 3d galvanized nails to each cleat.

Down Spouts, Spout Boxes and Stones.—Five inch galvanized iron down spouts of Irwin & Reber (Phila.) pattern, properly secured in place with banks and hold posts. Put a down spout in every other post, beginning with the first and ending with the last post of the shed, making 22 down spouts. The down spouts to be fitted at foot into square, ornamental, cast-iron down spout boxes of approved design, 5 ft. high, with base moulded to fit over coping of masonry and carried down to ground, where it is to waste on 12-in. blue stone spout stone set in paving.

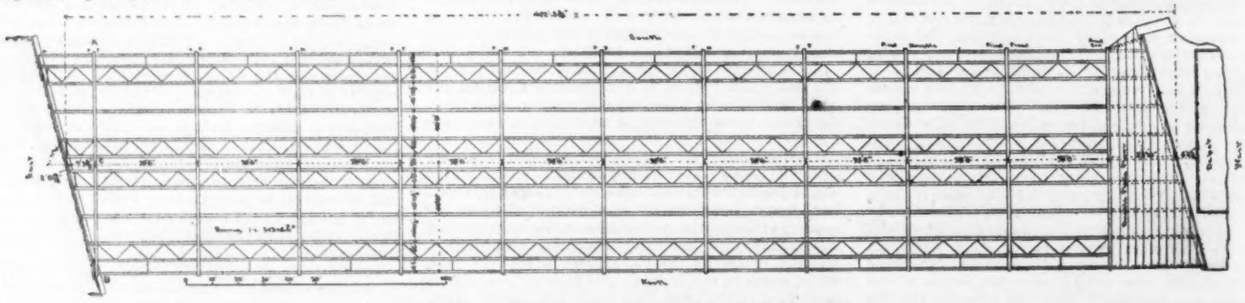
Snow Guard.—Put up a ¾-in. galvanized pipe guard on roof of ventilator, running along on each side the full length of roof, and put up in the most secure and substantial manner.

Cast Iron.—All ornamental cast-iron work must have a smooth finish and be free from air holes, cinder spots and other imperfections. All castings must be true and out of wind, and all joints must be dressed to a perfect fit.

The end finish castings for the north and south sides of east and west abutment bridge seats are not to be furnished until after the erection of the floor and the other castings are placed, when drawings for these castings will be made from exact measurement.

Glass.—Glaze the sash at both ends of shed with 14 x 20-in., second quality, single thick Balto. glass, well braided and puttied and back puttied, and hung with galvanized iron clips, one under each end of glass.

Paint, Wood Work, Roofing and Spouting.—All wood work inside of barge boards to be oiled two coats best linseed oil and then varnished. All wood work outside of barge boards to be painted three good coats linseed oil and white lead of such color or colors as the resident engineer may select. All tin and galvanized iron work to receive two coats of Druid Elastic Paint, brown (Druid Elastic Paint Co., Balto.), on each side.



Ground Plan of Pittsburg Train Shed, B. & O. R. R.

Wrought Iron.—The Baltimore & Ohio specifications for workmanship and quality of material for wrought iron bridges shall apply in full to all iron work.

As to design of the roof Mr. GREINER says:

It has long been the custom when designing roofs and such structures, subject to a static load and an intermittent wind pressure, to lump both pressures and consider them as acting vertically, or else to consider the dead load vertically and the wind horizontally, and then combine the results.

While such assumptions might be sufficiently close for the purpose of tendering bids, still they are not altogether correct when viewed from a more considerate standpoint. It has been amply demonstrated by experiment that when wind impinges upon an inclined surface, the action will be normal to surface, but of a

greater intensity than the normal component of the horizontal force.

The intensity is expressed by the formula:

$$P_n = P \sin. i \frac{1.84 \cos. i - 1}{}$$

where P_n = normal component,

P = horizontal pressure per sq. ft.

i = angle which the inclined surface makes with the horizontal.

If the action of wind be considered in this manner, the resulting stresses will in some cases be decidedly different from those obtained by using a vertical force alone. From this we see that there can be no possible excuse for neglecting the horizontal force of wind properly reduced, excepting that of lessening the amount of labor in our calculations, in which case, however, the before mentioned prominent bridge engineer would be justified in stating that the strains represent "a very rough guess."

Further, when a truss is supported upon a wall or other inflexible support provision is made for expansion by using rollers at one end, in which case the stresses will not be symmetrical on both halves of truss.

The correct design of a roof truss involves three cases, as follows:

CASE I.—Vertical static loading, including weight of snow, roof covering, purlins, truss, etc.

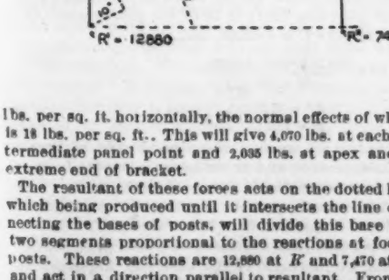
CASE II.—Effect of wind on leeward truss for roller and fixed ends.

CASE III.—Effect of wind on windward truss for roller and fixed ends.

The actual maximum stress will be found by properly combining these three cases, and in addition to these there will be a bending in the main rafters when purlins do not rest directly over panel points, which bending must be resisted by the material in the rafter.

When, as in the present example, a roof is supported upon flexible columns, it becomes necessary to stiffen the columns and connect them to the trusses in such a manner that there will be no danger of the structure collapsing under a heavy wind pressure, and still leave sufficient flexibility to admit of a little lateral deflection due to changes in temperature affecting the length of trusses. This stiffening is done by connecting the columns to rafters by means of brackets designed for their peculiar duty of resisting all tendency to collapse and be slightly flexible at the same time. The introduction of such a bracket between posts and main rafters will, of course, affect the strains in some of the truss members, therefore the common practice of neglecting its influence upon the strains is erroneous and should not be tolerated by careful men.

For instance, let Fig. 1 represent one of the main trusses subjected to the action of a wind force of 30 lbs. per sq. ft. horizontally, the normal effects of which is 18 lbs. per sq. ft.. This will give 4,070 lbs. at each intermediate panel point and 2,035 lbs. at apex and at extreme end of bracket.



The resultant of these forces acts on the dotted line which being produced until it intersects the line connecting the bases of posts, will divide this base into two segments proportional to the reactions at foot of posts. These reactions are 12,880 at R and 7,470 at R'', and act in a direction parallel to resultant. From the figure we see that foot of post is 10 ft. to left of line drawn through its top parallel to direction of forces consequently there is no difficulty in seeing from a very casual inspection, that the effect of the bracket will be to modify the strains in all members excepting Cd and Dd.

Hence it is obvious that the sometimes practiced custom in such cases, of considering the reactions at top of posts, will not by any means give the required maximum strains.

The author has also known engineers to figure stresses in roof trusses supported on columns, from vertical and horizontal pressures without considering that the effect of the horizontal is normal to slope. In figuring from this basis, they would contend that the tendency of wind was to overturn the entire structure about the base of leeward column, overlooking the important fact that in such structures there can be no overturning, the effect of a horizontal wind pressure being to crush the roof down to the ground and hold it there, unless indeed the supporting posts are so high, or the slope of the roof so steep, that the center line of gravity of the normal pressure passes outside the post pedestals, in which case, of course, there would be an overturning tendency, producing compression in the leeward and tension in the windward posts.

The roof in the present case was designed from the following data:

Length of span	84 ft., 0 in.
Depth of center	21 " 6 "
Distance between trusses	19 " 3 "
Height of posts	22 " 4 "

CASE I.—Vertical static loading:

Snow per square foot	12 lbs.
One-inch planking covered with tin	7 "
Purlins, etc.	5 "
Per square foot	24 lbs.
Weight per lin. foot for truss covering	460 lbs
" " " truss only	100 lbs
Total per lin. ft	560 lbs.

CASE II.—Strains due to wind blowing horizontally with a pressure of 30 lbs. per sq. ft., the normal effect of which is 18 lbs. Windward half of truss considered.

CASE III.—Wind as before. Leeward half of truss considered. The maximum strains will result from a proper combination of above, in addition to which, the main rafters are proportioned to resist a bending moment due to 800 lbs. per lin. foot uniformly distributed.

Working Loads:

Tension.....15,000 lbs. per sq. inch

Compression:

Square Ends.	Pin & Sq.	Pin Ends.
$\frac{10{,}000}{1+\frac{1}{36{,}000}\left[\frac{l}{r}\right]^2}$	$\frac{10{,}000}{1+\frac{1}{24{,}000}\left[\frac{l}{r}\right]^2}$	$\frac{10{,}000}{1+\frac{1}{18{,}000}\left[\frac{l}{r}\right]^2}$

Yellow pine in direct compression $\frac{1{,}050}{1+.002\left[\frac{l}{d}\right]^2}$

Timber for combined compression and bending not to exceed 1,200 lbs. per sq. in.

Concerning the calculation, nothing need be said since the conditions and data above given indicate clearly the method pursued.

The lower portion of structure, embracing the entire floor system, was designed to carry B. & O. 94.6 tons consolidated engines, followed by 3,300 lbs. per lin. foot and in addition to this, 100 lbs. per sq. ft., covering the platform between tracks, the allowed working strains being those given in B. & O. specifications for railroad bridges.

For the strength of pedestal posts and stability of structure, two cases were considered.

CASE I.—Maximum loading on posts in combination with maximum wind pressure.

CASE II.—Minimum loading on posts in combination with maximum wind pressure.

Case I, of course, gives the maximum direct strain, while the maximum bending will result under the condition of Case II. The direct strain in no case exceeds the safe working load derived from square bearing column formulæ with factor 5. Bending strain in extreme fibres does not exceed 12,000 lbs., or bending and direct combined 14,000 lbs.

Cantilever Bridge across Colorado River: California & Arizona Railway.

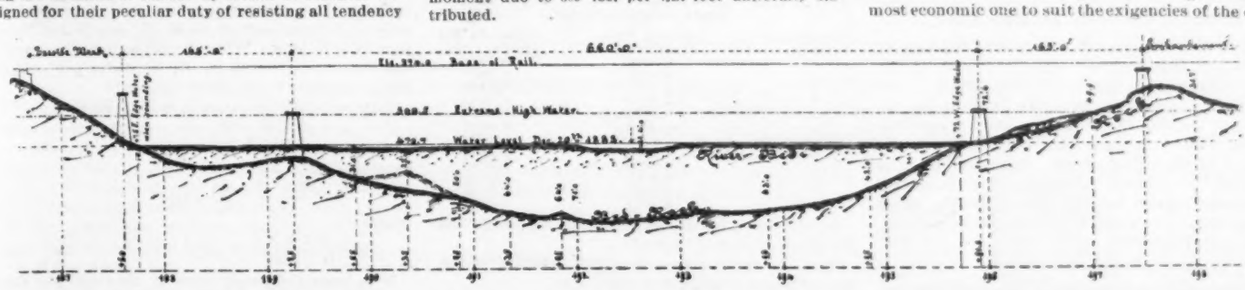
A contract for what, when finished, will be by far the largest cantilever bridge in America, was awarded to the Phœnix Bridge Co. on their own specifications and design, on Jan. 1, by S. M. ROWE, C. E., Chief Engineer of the Atlantic & Pacific Railway. This structure is to span the Colorado river at Red Rock, some 8 or 10 miles below the Needles, where the California & Arizona (a part of the A. & P. system) crosses the river by means of a temporary wooden bridge.

Borings made at the site in 1881, before Mr. ROWE was connected with the road, showed bed rock at from 25 to 28 ft. below low water. Upon this basis the contract was awarded, some 2 months ago, to J. A. L. WADDELL, the western representative of the Phœnix Bridge Co. At the same time Messrs. WADDELL & JENKINS, of Kansas City, Mo., were retained to make extensive borings to bed rock in the neighborhood of each of the proposed main piers. Instead of reaching rock at 25 ft., Mr. JENKINS found it at 65 ft., after which he made borings for a complete bed-rock profile, obtaining a depth of 72 ft. at mid-stream.

On account of the changed conditions, Mr. WADDELL was called upon to proceed to Albuquerque, N. M., to consult there with Mr. ROWE concerning the most economic structure for the crossing. A cantilever 990 ft. from center to center of anchorage was determined upon, the distance from center to center of main piers being 660 ft. The length of the suspended span is 330 ft., and that of each cantilever arm and each anchor arm is 165 ft. The panels are all 55 ft. long, being subdivided at mid-length. The depth of truss of the suspended span is 55 ft., and that of the structure over the main piers is 101 ft.

The final design, which is with two or three slight exceptions that originally submitted by Mr. WADDELL for the Phœnix Bridge Co., is thought to be the most economic one to suit the exigencies of the case, when everything is considered, although the proportions are unusual, and the weights are greater than they would have been could the main piers have been placed where desired. A glance at the accompanying profile will show, not only the necessity for a cantilever, but also for the location of the main piers involving such a long clear span.

The designs have been completed at the Phoenixville office of the Phœnix Bridge Co., and work is now being actively prosecuted in their shops. The entire work is to be pushed as rapidly as possible, so as to complete the structure in time to anticipate an impending washout of a portion of the road which follows the course of the Colorado river at a low elevation. We shall give further details hereafter of this interesting structure.



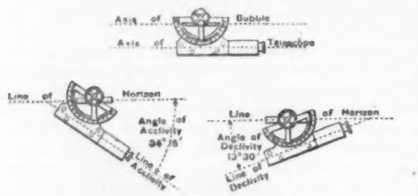
Profile of Site for Cantilever Bridge over the Colorado River. THE PHŒNIX BRIDGE CO., Engineers and Contractors.

The Sayre, Pa., Syphon.

Mr. A. P. BOVIER, City Engineer of Elmira, N. Y., suggests in connection with the syphon problem at Sayre, Pa., that W. A. S. place a chamber at the summit of his pipes, with a closed top, and stop-cocks above and below this chamber. After the syphon has been started, fill this chamber with water, the lower stop cock being closed. Then close the upper stop-cock and open the lower. This will allow the air in the pipe to rise into the chamber and keep the pipe full of water at the summit. Pounding on the chamber will show when it is nearly empty, and requires filling again; the lower stop being always first closed in such case. With all parts of the pipe tight, a chamber holding 30 or 40 galls. of water will last about 24 hours. Mr. BOVIER successfully used a chamber of this kind on a 6-in. syphon.

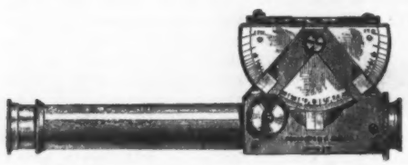
A Combined Hand Level and Clinometer.

The cuts herewith illustrate two substantially similar types of a combined clinometer and hand level which makes an extremely convenient instrument for either purpose. We find the instruments illustrated in an English work (USILL'S) on "Practical Surveying" recently reviewed in these columns. The Abney type, which is perhaps the best, consists of a small telescope to which is attached a quadrant graduated each way from the center for 90°. At the center of the arc is a spindle carrying a level and revolved by a milled screw. The level case is slotted underneath so as to make the bubble transparent.



Abney Level and Clinometer.

By the usual optical arrangement (a half-silvered mirror) the observation is taken by sighting at a given object or up or down a slope, and then turning the milled wheel until the bubble is seen coincident with the horizontal line of the half silvered mirror at its intersection with the distant point.



Reflecting Clinometer and Hand Level.

It will be seen that in taking a reading the arm of the vernier is always vertical. The cost of the Abney instrument in England is about $10.50.

The reflecting instrument shown by the larger cut is but half the cost of the Abney, the arc carrying the level, and being cogged on the edge so as to be revolved by the milled screw. The instrument is made with or without a vernier. For use on reconnaissance, or for taking slopes generally, these instruments are very useful and also serve as a substitute for a hand level.

The Pennsylvania Railroad Association of Maintenance of Way Engineers.

The following brief constitution and by-laws provide for an excellent organization worthy of imitation. We print it in full, not only for that reason, but as a somewhat amusing illustration of the tendency of every American to "form himself into a hollow square," so to speak, by some form of official organization, even when only two or three are to gather together. In this case there can only be 10 members, all told, under the constitution, all of whom are made members *ex officio*, one of them being permanent chairman as the ranking officer. A brief official order or request would seem sufficient to answer all requirements under such conditions; but that would savor of autocratic government, and would not be the American way. Some short and sweet document like this is liked better:

CONSTITUTION.

ARTICLE I.—*Name.*—The Association shall be called the Association of Maintenance of Way Engineers of the Pennsylvania Railroad.

ARTICLE II.—*Object.*—The object shall be the discussion and general improvement of the Maintenance of Way standard of the Pennsylvania Railroad.

ARTICLE III.—*Membership.*—The following shall be the members of the Association:—

The Assistant Chief Engineer, the four Engineers of Maintenance of Way, and the Assistant Engineers of the New York, Philadelphia, Middle, and Pittsburg Divisions, and of the West Jersey and Camden & Atlantic Railroads.

ARTICLE IV.—*Government.*—The Officers of the Association shall consist of a Chairman and Secretary.

The Assistant Chief Engineer of the Pennsylvania Railroad Company shall be Chairman of the Association.

ARTICLE V.—*Amendments.*—This Constitution can be altered or amended by a vote of two-thirds of all the members of the Association.

BY-LAWS.

1.—The regular meetings of the Association shall be held monthly, or at the call of the Chairman. Three days' notice shall be given to each member.

2.—Six members shall constitute a quorum for the transaction of business at any meeting of the Association.

3.—Inventors or owners of patent railway appliances shall not be permitted to be present at the meetings of the Association.

4.—The Secretary shall keep a true record of all meetings.

The Practical Calculation of the Heads, Diameters, and Discharges of Long Pipes.

(*Continued from Page 142.*)

BY E. SHERMAN GOULD.

The coefficients given below are those determined experimentally by DARCY. Of course, in the subsequent calculations which will be made, any other values might be substituted for the ones given. It is well to remark, however, in regard to the coefficient, that although this factor is a controlling one in the calculation of the discharge of pipes, it is useless to attempt an excessive refinement in establishing its value, because not only is it difficult to determine this value with exactness for a given diameter and condition of pipe, but this condition, and even the diameter of the pipe, is liable to undergo considerable variation in the same pipe in the course of a few years.

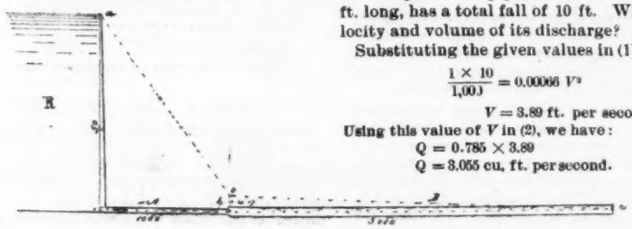


Fig. 4.

TABLE OF COEFFICIENTS.

Diameter in inches.	Value of C for rough pipes.	Value of C for smooth pipes.
3	0.00080	0.00040
4	0.00076	0.00038
6	0.00072	0.00036
8	0.00068	0.00034
10	0.00066	0.00033
12	0.00066	0.00033
14	0.00065	0.000325
16	0.00064	0.00032
24	0.00064	0.00032
30	0.00063	0.000315
36	0.00062	0.00031
48	0.00062	0.00031

In all the following calculations, the coefficient for rough pipes will be used.

The two fundamental equations relating to the flow of water through long pipes are:

$$\frac{D \times H}{L} = C\,V^2 \qquad (1)$$

$$Q = A\,V \qquad (2)$$

Equation No. 2 will generally be written:

$$Q = A\sqrt{\frac{D \times H}{C \times L}} \qquad (3)$$

by taking the value of V from (1).

The first of these has been established by DARCY; the second is based upon a self-evident proposition.

In these equations:

D = diameter of pipe in feet
H = total head " "
L = length of pipe " "
C = coefficient
V = mean velocity in feet per second,
Q = discharge in cubic feet per second,
A = area of pipe in square feet = $D^2 \times 0.785$.

The above two formulæ solve, directly or indirectly, all problems relating to the flow through long pipes, and all such problems must be brought into a form admitting of their application, in order to obtain a solution.

It will be observed that $\frac{H}{L}$ is the rise or fall per foot of length of pipe, and is therefore the natural sine of the inclination of the slope to the horizon. This relation is frequently used under the symbol $I = \frac{H}{L}$. Using this notation, (1) would be written:

$$D\,I = C\,V^2$$

In long pipes the length is generally taken as being equal to the horizontal distance separating the two ends of the pipe, as the difference between this distance and the actual length of the pipe is relatively insignificant. If, however, a case should present itself in which this difference was considerable, the actual length of pipe should be taken. Further on, an extreme case of this kind will be given, presenting some interesting features.

Some practical examples of the use of this formula will now be given. In all that follows, the resistances of entry, exit, and velocity will be neglected, and the total head will be considered as available for overcoming friction. The examination of cases where the above factors are included is reserved for a later portion of this paper, as they are of secondary importance when dealing with long pipes.

Example 1.—A pipe, 1 ft. in diameter and 1,000 ft. long, has a total fall of 10 ft. What are the velocity and volume of its discharge?

Substituting the given values in (1) we have:

$$\frac{1 \times 10}{1{,}000} = 0.00066\,V^2$$

$$V = 3.89 \text{ ft. per second.}$$

Using this value of V in (2), we have:

$$Q = 0.785 \times 3.89$$

$$Q = 3.055 \text{ cu. ft. per second.}$$

Example 2.—Two reservoirs, having a difference of level of water surface of 80 ft., are joined by a pipe 3,000 ft. long. What should be the diameter of the pipe to deliver 16 cu. ft. of water per second from the upper to the lower reservoir?

Eliminating V between (1) and (2) we have:

$$\frac{D \times H}{L \times C} = \frac{Q^2}{A^2}$$

Observing that $A = D^2\,0.785$;

$$\frac{D \times H}{L \times C} = \frac{Q^2}{D^4 \times 0.616}$$

Whence

$$D^5 = \frac{Q^2 \times L \times C}{H \times 0.616} \qquad (4)$$

If we knew the proper value of the coefficient C in the above equation, it could be immediately solved, and the value of D obtained. But C varies with the diameter, and the diameter is as yet unknown. We must, therefore, have recourse to "Trial and Error" for a solution.

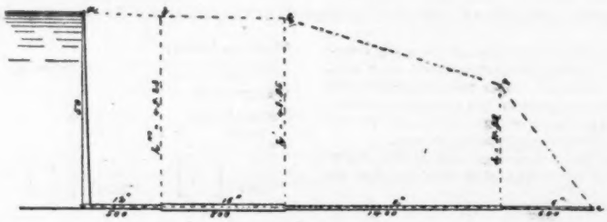


Fig. 5.

Suppose it should appear to us, at first sight, that a 12-in. pipe was likely to be of the proper size. We therefore take $C = 0.00066$, and write:

$$D^5 = \frac{256 \times 3{,}000 \times 0.00066}{80 \times 616}$$

$$D^5 = 27.70$$

$$D = 1.94 \text{ ft.}$$

From this we see that the pipe should be nearly 2 ft. in diameter, and as we have taken too large a coefficient (that for 24 ins. = 0.00064), we are sure that 1.94 is too large. As pipes are never made of fractional diameters, the above value of D would be taken = 24 ins., and therefore we would push the calculation no further. If the case had happened to be one requiring minute accuracy, we would recalculate the above equation, using 0.00064 for the value

of C. The result would be, $D = 1.96$ ft. nearly, differing very slightly from the value already obtained.

The above examples (which are those commonly occurring in practice) are very simple, and involve only the direct application of the fundamental formulæ. Let us now consider cases of a more complicated character, where they can only be used indirectly, and where a certain amount of judgment and tact is required in the preparation of the data.

Example 3.—Suppose a reservoir R (Fig. 4) containing a depth of water of 50 ft. above the center of the horizontal pipe A, 1 ft. in diameter and 1,000 ft. long, connected by a reducer with another horizontal pipe B, 2 ft. in diameter and 3,000 ft. long. It is required to calculate the piezometric head h at the junction, from which the discharge can be calculated, and the hydraulic grade line abc established.

It is evident that the 24-in. pipe must, under the head h, discharge the same quantity per second as the 12-in. pipe, under the head $50 - h$. We have then from (3), the equality:

$$3.14\sqrt{\frac{2\times h}{3000\times 0.00064}} = 0.785\sqrt{\frac{1\times(50-h)}{1000\times 0.00066}}$$

Dividing by 0.785, squaring, and simplifying:

$$\frac{h}{0.02} = \frac{50-h}{0.22}$$

whence

$$h = 4.17$$

We can now very readily get the discharge, by substituting the value 4.17 for h in either member of the above equality. Thus:

$$Q = 3.14\sqrt{\frac{4.17}{0.96}} = 6.54 \text{ cu. ft. per sec.}$$

Verifying in the other member—a precaution which should never be neglected—we obtain the same result.

Suppose that in the above example, the places of the two pipes, A and B, should be changed. Evidently we should have:

$$h = 45.83$$

This piezometric height would give, with the transposed position of the pipes, the same discharge as before, the only difference being a notable change in the hydraulic grade line. If the pipes were tapped by branches, the greater elevation of the grade line in this case would bring a much greater pressure upon the branches, enabling them to deliver water at a higher level than in the first position of the pipes.

The above example may be extended so as to cover cases where pipes of several different diameters are used. Thus, suppose a system of pipes, such as is shown in Fig. 5, where a reservoir with a head of 50 ft. of water, as before, is tapped by a horizontal line of pipes, consisting in order of 500 ft. of 12-in., 800 ft. of 16-in., 1,400 ft. of 8-in., and 600 ft. of 6-in. pipe.

This example may be worked in the same way as the previous one, by getting equations for h, h', and h'' expressed, by substitution, in terms of h. But it will be easier to treat the question in another way, which will also exhibit the further resources which we have at our disposal in solving hydraulic problems.

(TO BE CONTINUED.)

PROFIT SHARING.—The employés of the Springfield Foundry Co., of Springfield, Mass., have received their second annual share of the profits of the business, amounting to 3 per cent. on their total wages for the past year. The previous year's dividend was 2½ per cent. In France, where the system of profit sharing has been for many years in vogue in a large number of successful establishments, there has been since 1878 a society devoted to the study and encouragement of the different modes of sharing profits with employés, and it publishes a periodical in the interest of the plan. This society will take part in the coming exposition at Paris and will have an exhibit in a special pavilion, showing, among other matters, the names of profit-sharing concerns all over the world and giving information as to the methods followed and amounts paid to employés by each.

Safe Stresses in Bridges.

The accompanying diagram will make clearer the communication from A. D. OTTEWELL, under the above head, which appeared in our last issue. To make the diagram clearer we reset the essential parts of the communication.

The equilateral hyperbola, used by many of our best engineers, is based upon the assumption that the allowable unit stress for live or variable load is constant for all values of $\frac{m}{M}$. Now my experience leads me to believe that this unit stress is a variable, that it is less in a counter than in a chord, is less in a chord of a short span than in a chord of a long one. In other words, instead of the equation:

$$\frac{M}{a} = \frac{m}{t} + \frac{M-m}{u}$$

we should have

$$\frac{M}{a} = \frac{m}{t} + \frac{M-m}{u\left(1+v\frac{m}{M}\right)} \qquad (1)$$

By solving this equation and assuming that

$$t = n, u \qquad (2)$$

and $$v = \frac{2n}{3} - 1 \qquad (3)$$

we derive the equation

$$a = \frac{t\left\{1+\left(\frac{2n}{3}-1\right)\frac{m}{M}\right\}}{n-\left(n-1\right)\frac{m}{M}+\left(\frac{2n}{3}-1\right)\left(\frac{m}{M}\right)^2} \qquad (4)$$

The dotted lines in the diagram illustrate this curve for the two cases: $u = 7{,}500$, $t = 15{,}000$, $u = 5{,}000$, $t = 15{,}000$. The straight lines with which these curves so nearly coincide are the well-known straight line,

$$a = u\left(1+\frac{min.\ B}{max.\ B}\right) \qquad (5)$$

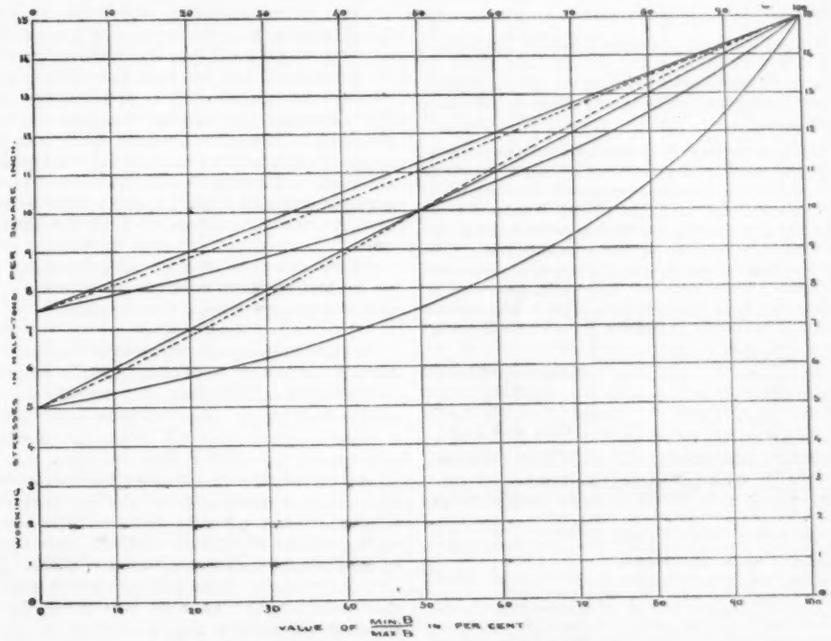
and the straight line I proposed two years ago,

$$a = u\left(1+2\frac{min.\ B}{max.\ B}\right) \qquad (6)$$

respectively, and it goes without saying that no practical engineer would hesitate to use these instead of the curves.

The full curved lines are the equilateral hyperbola forms for the same limiting values.

I regret that I have not the leisure to state as fully as I could wish the reasons upon which equation 4 is based. The chief assumption, viz., that the allowable unit stress for live or variable load varies for different values of $\frac{m}{M}$ is, I believe, consistent with the experience of all engineers.



Safe Stresses in Bridges. Stress Diagram.

Foreign Coins.*

CUSTOM HOUSE VALUE.

Country.	Gold.	Silver.
Argentine Rep.	Argentine ($4.83). ½ Argentine.	Peso (96½ cts.) Parts of a Peso.
Austria	4 Florins ($1.93). 8 Florins ($3.86). Ducat ($2.29) and 4 Ducats ($9.16).	1 Florin, 34½ cts.) 2 Florins.
Belgium	10 and 20 Francs.	5 Francs (96½ cts.)
Bolivia		Boliviano (70 cts.) Parts of a Boliviano.
Brazil	5, 10 and 20 Milreis.	1 Milreis (54½ cts.) ½ Milreis, 2 Milreis.
British Possessions, N. A.		Dollar (100 cts.) Parts of a Dollar.
Chili	Escudo ($1.82).	Peso (91 cts.)
	Doubloon ($4.56), and Condor ($9.12).	Parts of a Peso.
Cuba	Doubloon ($5.02).	Peso (92½ cts.)
Denmark	10 Crowns ($2.68). 20 Crowns ($5.36).	
Ecuador	Condor ($9.65). Double Condor.	Sucre (70 cts.) Parts of a Sucre.
Egypt	Pound (100 Piasters) $4.94.	1, 2, 5, 10, and 20 Piasters.
France	5, 10, 20, 50, and 100 Francs	1 Franc (19⅓ cts.) ½ Franc, 2 Francs.
German Empire	5 Marks 10 and 20 Marks.	1 Mark (23⅚ cts.)
Great Britain	Sovereign (Pound Sterling) $4.86⅔ ¼ Sovereign.	1 Shilling (24⅓ cts.) Crowns, Florins, Sixpences.
Greece	5, 10, 20, 50, and 100 Drachmas.	5 Drachmas (19⅓ cts.)
Gautemala		Peso (70 cts.) and Divisions of Peso.
Hayti		Gourde (96½ cts.)
Honduras		Peso (69⅓ cts.)
India	Mohur ($7.10).	Rupee (33 1-5 cts.) and div. of Rupee.
Italy	5,10,20,50 and 100 Liras	5 Liras 1 Lira (19 3-10 cts.
Japan	1 Yen (99 7-10 cts.) 2, 5, 10 and 20 Yen.	Yen 75⅓ cts.)
Mexico	Dollar ($0.98). 2½,5,10 and 20 dolls.	Doll. or Peso (76 cts.). Divisions of Peso.
Netherlands	10 Florins ($4.02).	½,1 and 2½ Florins.
Nicaragua		Peso (70 cts.) and Divisions of Peso.
Norway	10 Crowns ($2.68). 20 Crowns ($5.36).	
Peru		Sol (70 cts.) and Divisions of Sol.
Portugal	1 Milreis (1.08). 2, 5 and 10 Milreis.	
Russia	Imperial ($7.72). ½ Imperial ($3.86).	¼, ½ and 1 Rouble. 1 Rouble (56 cts.)
Spain	25 Pesetas.	5 Pesetas (19 3-10 cts).
Sweden	10 Crowns ($2.68). 20 Crowns ($5.36).	
Switzerland	5,10,20, 50 and 100 Francs.	5 Francs, 1 Franc (19 3-10 cts).
Tripoli	Same as Turkey.	
Turkey	25,50,100,250, and 500 Piasters. 1 Piaster (4 ⅓ cts.)	
U.S. of Colombia	Condor ($9.65). Double Condor.	Peso (70 cts).
Venezuela	5,10,20,50 and 100 Bolivars.	5 Bolivars. 1 Bolivar (14 cts).

* From the Report of the Director of the Mint, with slight additions.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club, Philadelphia, Pa.—Regular meeting, March 2. Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Regular meeting, March 4. "Strengthening Iron Bridges," C. E. Taylor. Secy., Kenneth Allen, 310 Baird Building.

Western Society of Engineers, Chicago, Ill.—Regular meeting, Mar. 6. Secy., John W. Weston, Gaff Building.

American Society of Civil Engineers, New York.—Regular meeting, March 6. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting, March 6. "Shortage on Coal in Car Lots," T. D. Miller; "Improving the Channel of the Mississippi," W. Alderdice. Secy., Wm. H. Bryan, 709 Market St.

Civil Engineers' Club of Cleveland, O.—Regular meeting March 12. Report on Applied Science. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass.—Regular meeting, March 13. Boston & Albany passenger station.

New Eng. and Water-Works Association.—Next meeting, March 13. Secy., W. C. P. Corgeshal, New Bedford, Mass.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, March 19. Secy., S. M. Wickersham, Penn Bldg.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, March 20. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, March 21. Rooms, 113 Liberty St., New York City.

AN IMPATIENT correspondent, who favored us with a communication dated Jan. 29, which is likely to appear in due time, "if the bottom does not fall out of everything," writes us saying:

> I would like to know why my communication of Jan. 29, concerning . . . has not been published. I do not understand why any partiality should be shown toward some of your subscribers. . . . I will have it published in another paper if you have no intention of doing so.

We so frequently have communications of this kind, inquiring why something sent us yesterday was not published to-day, that it seems worth while to explain, once for all, that delay of weeks, or even in some cases, months, is a frequent and necessary contingency, and must not be assumed as implying rejection or an undervaluation of the communication. Contrary to what seems to be a current impression, we have, as a rule, accepted matter enough on hand to fill two or three papers ahead if we accepted nothing else; consequently, we cannot assure immediate publication to anything. A dozen causes besides the merit of the paper, or no cause at all, may give one or another article the precedence, nor can we undertake to establish or look after an order of appearance among articles. Length, topic, number and condition of drawings, variety of subject matter, and a dozen other causes besides mere accident, which alone is an important one, affect date of publication. Above all, all matter is primarily divided, when it comes into a newspaper office, into "must" and "may." "Must" is matter that loses its value and interest if not immediately published. "May" is matter that is as good and as interesting next week or next month as this. We have now "may" matter which has been on hand over a year, and considerable which has been on hand three or four months; and a good part of it has been held over for the very reason that it was of such interest and value as to demand prominence when presented at all. For example, an illustrated account of the great San Mateo dam, which will probably appear next week, has been on hand since last October. Our paper had chanced to be running to dams so much for some time before that we thought it best to hold the article over.

All articles sent in must be understood to be subject to these contingencies, nor do we ordinarily acknowledge their receipt.

THE way to bury electrical wires "is to bury them," according to Mayor GRANT's remarks of last week concerning the status of conduit affairs in this city. By all means, bury them; it is the only practical way to find out whether our conduits are fit for such purposes or not. If the wires fail to work under fair treatment, there may be ground for a suit for damages against the city; but there would also be an earlier chance of settling upon the best form of conductor for such underground wires. At this time we only know that one party insists that the conduits are practically perfect, while another says they are water-logged, gas-soaked, and worthless. This dispute can only be settled by a practical, extensive test, covering a considerable length of time; and we cannot begin such a test too soon if the law requiring the ultimate burial of all electrical wires, and the removal of poles and wires from our streets, is to be carried out in this generation. More time spent in preliminary examination of this very important subject by a board of undoubted experts in electrical and civil engineering might have resulted in a more reliable system of conduits; but as we have the conduits, let us now bury the wires, and find out as soon as possible what the conduits are worth.

A CORRESPONDENT from the far-away point of Corvallis, Oregon, Mr. J. BERNARD WALKER, takes us to task for asserting, as we did in our issue of Jan. 26, 1889, that the test speed of the *Vesuvius* "surpassed all previous records of speed for vessels of any size whatever." He calls our attention to the fact that the torpedo-boat *Ariete*, built by Thornycroft of London for the Spanish Government some 2 years ago, "realized 26 knots per hour, being 4½ knots ahead of the speed shown by the *Vesuvius*," and this, he says, was a mean speed, during "exhaustive trials," which we infer was by successive trips over the measured mile. Mr. WALKER's point is well taken as respects our literal statement, which we accepted on the strength of an apparently inspired press report, issued from the vessel immediately after the trial, after checking it by a number of other reported fast tests, which we have published, among which we did not happen to strike the *Ariete*. Practically, however, the statement remains correct, if we include as "vessels" only those capable of going to sea and maintaining high speed for at least 24 hours. The *Ariete* is a mere harbor-shell, 147 ft. 6 ins. long, 14 ft. 6 ins. beam, 4 ft. 11 ins. draft, and incapable of maintaining high speed for more than a few hours. Its tests (if our memory does not deceive us) were over a measured mile in smooth water, and not in a 4 hours' run on what is almost like the open sea, Delaware Bay. "We say not this to cry her down." She is a wonderful boat, and her 26 knots an hour has yet to be beaten; but her existence does not in any way affect the real point made as to "vessels," since the *Vesuvius*, although sometimes miscalled a torpedo boat, is really a sea going "dynamite cruiser" of nearly 800 tons burden. Technically, we suppose that any craft that floats is a "vessel," but it is obviously unfair to compare a mere shell with machinery in it with sea-going craft.

A CORRESPONDENT from Oregon, in another column, calls attention to an important distinction between the yellow and red firs of the Pacific coast which demands attention from the increasing class who buy Pacific coast timber for various purposes. It appears that the yellow fir is a very durable and good timber, while the red fir is quite the reverse, the distinction being something like that which is well known to exist between red and white oak, only still more pronounced. This fact is doubtless familiar enough to those who have had some years' experience with Pacific coast timbers, but others need to be on their guard.

IT has happened several times within the past month that vacancies for engineers have been advertised in these columns, and desirable men secured at short notice who would otherwise have known nothing of the existence of vacancies, although far better qualified to fill them than the men who were in the beginning known to the advertisers. This fact leads us to again call the attention of engineers to the difficulty under which men desiring new engagements labor in this respect, a difficulty inseparable from the nature of engineering work, which, especially for young men who have not yet won high rank in the profession, is intermittent and widely separated in locality, especially in this country. It is greatly to be desired, therefore, that the same practice should obtain here that obtains in England, of announcing the existence of vacancies through some engineering journal, in order that every man who wishes may have opportunity to make application by letter. It does not necessarily follow that any applications will be considered, but as a rule—we speak from repeated observation—astonishingly well-qualified men will be found to be, for the moment, anxious to accept any engagement, and thus the great rule of fair play, "Let the best man win," has a chance to be more fully carried out.

IT is perhaps because it is only recently that a recognized professional organ of large and general circulation has existed in this country that this practice has not become general, for justice and fair play, as well as good sense, plainly require it. The engineer who has a vacancy to fill is not doing justice, either to himself, or to his employers, or to his profession, or to his younger contemporaries, who fills it hastily and hap-hazard with some man who happens to be at hand but is not conspicuously deserving, without first seeing if there be not some man whom a brief "Want" notice will bring to his knowledge, who might reasonably expect twice the salary, but who for the moment is "out," and wants to get in again on almost any terms. This is

more conspicuously so because, as we all know, there are many eminently capable and deserving men who lack that keen scent for the main chance and faculty of nosing around betimes by which many men, who are otherwise not particularly meritorious, secure positions continucusly. Of course any such public notice of a vacancy brings many applicants who are really not entitled to consideration; but the only consideration they can claim is a brief glance over their letter, and even if all applications prove of this class—a most unlikely contingency—no great harm has been done, and the engineer then has the satisfaction of knowing that he is not doing some unknown and worthy man injustice by giving him no chance.

Lawyers, doctors, architects, etc., are in less need of any such common medium of exchange, since their work lies in one place continuously, yet they use such in their professional journals much more than engineers do. The English engineering journals are full of such notices, and we are glad to say the practice is increasing here; but it ought to become universal.

THE earthquake in Costa Rica on Dec. 29, last, appears from further reports to have been among the most frightful catastrophes of the kind on record, as respects this continent, and the incident derives additional importance from the fact that the center of the disaster, San José, the capital of Costa Rica, a city of about 20,000 inhabitants, is only about 100 miles due south of the line of the Nicaragua canal. About 200 lives and millions of property were destroyed, and nearly 2,000 more persons were injured, while it is reported, probably with considerable exaggeration, that "the topography of the country for an area of 30 or 40 miles around was completely changed."

It appears clear, however, that there was very considerable disturbance of the topography, and that a number of people were swallowed alive by the opening of cracks in the earth. It appears also that in 1841 there was another frightful earthquake in this region, which caused the abandonment of an old capital, which is now a mere hamlet, but which this time has escaped with slight injuries. It is not without significance that it is now seriously contemplated to remove the capital again to some point on or nearer to the route of the Nicaragua canal, possibly at the head of the large bay which it now appears will be formed by the flooding of the valley of the San Carlos river by the great dam at Ochoa on the San Juan river, through which Lake Nicaragua discharges into the sea. The San Carlos rises far to the south, in Costa Rica, and empties into the San Juan just above this dam.

WHAT effect is this earthquake danger likely to have on the Nicaragua canal? It is undoubtedly an unpleasant feature of the locality, and we think may well cause trouble at some time or other, since there have been in the past some quite serious earthquakes and eruptions of volcanoes very near to the route of the canal. That it will ever do any serious or irreparable harm to the canal, however, we do not believe. The serious dangers appear to be only three: injury to a lock, disturbance of the slopes of the great rock cut, destruction to a dam or embankment holding water. The last danger is minimized by the adoption of heavy rock fills reinforced by earth, in place of masonry or concrete, in substantial accordance with the method suggested in this journal in August last. This gives an enormously thick base in proportion to the height, and gives practical security against sudden destruction of a dam by any casualty.

The locks of the project are all founded on rock, and some of them in an excavated rock basin, merely faced with concrete. Such a structure, it seems to us, is hardly likely to be injured seriously by an earthquake. It is noticeable that earthquakes do their greatest damage to buildings, all of which have relatively thin bases compared with height. Engineering structures of small height and broad base are rarely injured by the most serious earthquakes, as is well illustrated by the view of the slender ancient aqueduct at Zempoala, Mexico, described in this journal July 7, 1888, and now at least 316 years old. It is 109 ft. high, 3,000 ft. long, and barely large enough to carry an 8½ × 12 in. water channel; yet it is standing intact to-day, although it has undoubtedly been through many earthquakes, such as would throw down or badly crack ordinary houses. The third danger, of falls from the great rock slope, which for a short distance is over 300 ft. high, although averaging only 120 ft., is a more serious one, and cannot be regarded as impossible, but an earthquake could hardly shake the rock down very far back from the slope, and after it had once happened it would not be likely to happen again. As a whole, therefore, the most to be feared seems to be a certain money loss every 20 years or so. It is conceivable that some convulsion of nature might sink Central America below the sea, canal and all, as it might all North America, but such extreme contingencies are with justice excluded from ordinary calculations.

The Massachusetts Crossing Report.

A very valuable report, which we have already briefly noticed, but which demands more extensive summary and discussion, has recently been published in Massachusetts, being the result of an investigation, made by order of the Legislature, by a Board of Engineers, into the practicability and cost of gradually abolishing grade crossings of streets and railways. It is a significant evidence of the small hold which the American Society of Civil Engineers yet has upon the public, by the way, that only one of the three members of the Board is a member of that Society; but that they were eminently qualified for their duty and faithfully discharged it, their report bears strong evidence.

The Board of Railway Commissioners has for some reason been ignored in this matter. The Board of Engineers are instructed to report in print to the "General Court" upon the whole question, including apportionment of cost and damages, and $10,000 was appropriated for the total expense, the Board having been engaged on the work about 7 months, and having personally inspected all the crossings in the State.

The Board give heliographic views of 17 of these crossings, with maps of about as many more, and carefully divide all the crossings in the State into the following 7 classes of grade crossings, and classes of over or under-crossings.

	No. of Crossings	Est. ave. cost of removal.
I. Common country roads having no buildings to be affected by change.	1,068	$ 7,000
II. Country roads with buildings near..	713	12,000
III. Village streets with rows of houses near	243	18,000
IV. Village squares with tracks running through them	84	50,000
V. City streets, rows of buildings near and usually with 2 or more tracks.	184	90,000
VI. Several city streets intersecting at one point	22	150,000
VII. City streets with ponds, canals, or rivers near to complicate problem	3	200,000
Total crossings of highways at grade	2,367	
Highways crossing over tracks..	470	
" " under "	278	
Total over, under and grade crossings	3,015	
Grade crossings protected by gates, flags, or bells	792	
Grade crossings unprotected	1,475	
	2,267	

Crossings having view obstructed by shrubbery	330
Crossings having view obstructed by high banks	180
Crossings having view obstructed by buildings	768
Crossings having view unobstructed	989
	2,267

The last column gives an estimate by the Board of the average cost of removing each of the several classes of grade crossings, based upon a summary of actual cost in a goodly number of cases, which, as an interesting and valuable record in itself, we give condensed below.* As a whole, the estimated average cost per crossing seems a liberal one, and by multiplying the last two columns above together, the Board obtain the large aggregate of $40,766,000 as the total cost of eliminating all grade crossings in the State, a total which should really be still larger by $1,800,000, or $42,566,000 in all, only 164 instead of 184 crossings of Class V having been used in making up the total, by a curious numerical error.

We are inclined to regard this estimate as over-liberal. It seems to us more likely that $30,000,000 would do the whole work; but taking $42,000,000, at 4 per cent., the gross cost per annum to the Commonwealth of the improvement will be $1,680,000, which is in the neighborhood of $90,000 per life (if charged all to that) the average loss of life for 6 years having been 18, with 26½ injured. Before seeing what this means, however, let us complete the summary of statistical facts which precedes the recommendations of the report.

The most important and pertinent of all, the number of deaths and injuries at crossings, the Board very singularly fail to give. We have compiled ourselves the average just mentioned. But one significant fact they do bring out, and we give it in their own words:

> "Gates and flagmen do not protect. They are not a barrier against a restless people, impatient of a moment's delay. If the gates effectually closed up the road and kept people away from the track until it was safe to cross, they would be much better; but at present only a few of the foot passengers pay any attention to them; 170 persons have been either killed or injured in the State within 10 years *at crossings where gates and flagmen were established*. (Italics ours.)
>
> The number of crossings protected has increased 40 per cent. within 7 years; but, instead of bringing about a reduction of accidents, there have been within the past 7 years 33 per cent. more crossing accidents than in the 7 years preceding. About 40 per cent. of all the crossing accidents have occurred at protected crossings."

In view of the fact that protected grade crossings are less than 35 per cent. of the whole, but have 40 per cent. of the accidents at them, the degree of protection secured by gates and flagmen cannot be said to amount to much, after making all allowances for the much heavier traffic over such protected crossings; while, taking the cost of so protecting a crossing at $800 per year, including extra track work, it amounts at 4 per cent. to interest on $20,000. Contrast with this the fact that the average estimated cost of taking out all the 2,267 crossings is only $18,800 each, by the Board's very liberal figures.

The report shows that in the past 10 years 75 crossings have been taken out, *while* 155 *new ones have been added*. It justly points out that the first step in reform should be to stop the making of new crossings. It does not by any means follow, however, nor is it probably the

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* The crossings listed are as follows:

	Cost each.
27 Mass. crossings listed separately	$9,000
14 Conn. crossings in Deerfield	4,800
32 Conn. crossings abolished in 1887	5,722
2 " " " " 1886	5,000
2 " " " " 1885	3,250
14 N. Y., N. H. & H. crossings	8,364
45 N. Y. city crossings by 4th Ave. impt., cost including tunnel and 4 tracks, $6,100,000 or allowing half for the latter say	67,778
21 Crossings saved by Rochester, N. Y. imp't. 2 miles long at cost of	45,000
21 overhead crossings by Harlem imp't. costing $2,000,000 including 4 tracks, or say for eliminating grade crossings, $1,050,000	50,000

truth, that the 75 crossings did not have far greater dangers than the 155 have been added.

The Board likewise dwell on the truth that it is usually much cheaper to avoid a grade crossing in the first place than to take it out afterwards, and point out that, even if the making of new crossings were prohibited, it would take 302 years, at the rate of the past 10 years, to eliminate them altogether. They justly think that nothing but the force of positive law will adequately hasten the process, and recommend a law requiring that 5 per cent. of the crossings on all dividend-paying roads and 2½ per cent. of those on non-dividend-paying roads be taken out yearly, with a proviso that this proportion of the estimated total cost instead of the number of crossings may be accepted.

Before considering the recommendations as to how the expense is to be distributed, let us see what these facts mean, and to what extent such measures are expedient for the community as a whole. According to the last report (1888) there were in the State:

Main line	2,018 miles
Double track	740 "
Average cost per mile	$75,364
Total cost in Mass. say	$160,000,000
Present net income, av. say	5.8 per cent

To take out all the crossings, therefore, at the estimated cost of $40,000,000, would add about 25 per cent. to the present capital account, and hence to the necessary net earnings. This does not mean, however, even if the whole change were made this year, that rates would have to be increased 25 per cent. to cover the additional capital charge. On the contrary, to earn $1,680,000 more, they would have to be increased only about 3 per cent. (3.13) as will appear from the figures below. Moreover, a not much greater decrease in operating expenses would save all need of increase in rates; and still further, traffic is growing so rapidly, even in Massachusetts, that the burden of any such expense is constantly and very rapidly decreasing. The change in 9 years has been:

	1877-8	1886-7	Incr. p. c.
Total income, millions of dollars	29.05	53.65	84.6
Op'g expenses, " " "	19.82	37.28	103.9
Rentals, " " "		3.14	
Net income, " " "	9.23	13.23	43.4

It will be clearly seen from these figures that, however loth corporations may be to spend the money, removal of grade crossings at the rate proposed by the Board, so as to eliminate them in 20 years, is not likely to be a very burdensome requirement. It will cost at the outside $1,500,000 per year, which would be equivalent to increasing expenses and rentals only 3.75 per cent. to-day if it all fell on the railways (which is not proposed) but only about 2 per cent. ten years from now. The community as a whole, at any rate, will not feel this expenditure as a burden.

Now, what does the community gain? It saves first, as we have seen, some 18 lives and 27 injuries per year by eliminating all crossings, the yearly cost of doing which is about $60,000 per life and $20,000 per injury; and, if that were all, we take the liberty of saying at once, at whatever risk of misconstruction, the saving of life and limb would come pretty dear. It is more than the community is in the habit of paying, at any rate, if not more than it can afford, as is shown in a thousand matters like staging for carpenters and masons, clearing of sidewalks, protection against moving machinery, bad plumbing, and ventilation, etc., where larger expenditure, which is not incurred, would save many lives which are yearly lost. We do not say that it ought not to be incurred, but we do say there is some excuse for hesitation in respect to grade crossings, unless a harder law is to apply to them than the public applies to its own affairs.

But this is only a part of the matter. For every life actually lost, there are a dozen in imminent danger, and probably a thousand who suffer indirectly on the principle that "he who lives in fear of death at every moment feels its terrors." Could every man imitate the brave man who said this, by adding, "I will die but once," this feature of the problem might not so much matter; but unfortunately few can, especially if they have women and children in their charge, and the aggregate of anxiety and fear caused by the existence of these crossings is a very serious matter, which would be cheaply removed by the expenditure of a large sum. Let us roughly estimate the minimum number of teams only which are exposed to danger at grade crossings in Massachusetts. We may say that there are:

At 1781 country road crossings at least 10 teams per day each, average	17,810
At 277 village crossings at least 40 teams per day each	11,080
At 209 city crossings at least 200 teams per day each	41,800
Total per day	70,690
Or per year, teams	25,801,850

There are few persons, starting out on a drive which includes passing four or five grade crossings, who would not be glad to be rid of the annoyance and risk by paying a quarter; and 5 cents each, on the above minimum estimate, would alone amount to $1,290,000 per year, or nearly enough to cover the cost of eliminating all crossings on this score alone. Really, could we state the full number of teams passing crossings, it would probably cover it two or three times over.

Again, but for extreme caution on the part of the public and the railways, there would undoubtedly be many times more casualties, and such caution costs money, or time, which is worth money.*

If there were no highway grade crossings in Massachusetts, the speed of trains could undoubtedly be very much accelerated, with the probable result of a considerable decrease in operating expenses, and increase in earnings, from a variety of causes besides the direct saving in cost of maintaining gates and flagmen. Again, capitalizing the latter at $20,000 per crossing, as we did above, the State of Massachusetts has already in effect $15,840,000 invested in them, all of which is released to go toward the $40,000,000 required to take out all crossings, protected and unprotected.

As a whole, therefore, the case in favor of eliminating all grade crossings in a State like Massachusetts is immensely strong, and little if any weaker in any other well-settled States, like New York and Pennsylvania. As respects the more objectionable crossings and the more densely settled districts of all States, the argument is even yet stronger, while throughout the country there are many crossings which might have been originally avoided, or can now be taken out at very trifling cost. The recommendation that every road shall be obliged by law to take out 2½ to 5 per cent. of its crossings annually seems therefore most reasonable.

As respects distribution of the expense, the Board advise emphatically that the railways shall not bear the whole expense, as the public has been a consenting party to the present style of construction. They advise that, as a rule, the expense shall be equally divided, but that each case shall be investigated on its own merits, and they wisely recommend that the apportionment be made by a permanent Board or Commission, "in order that whatever experience is gained from year to year may be utilized." If the State were to adopt their recommendations, and so require some 60 or 70 crossings per year to be taken out, the time of one Board would be fully occupied in attending to the apportionments and related business, and the general Railroad Commission could hardly attend to it properly.

The bulk of the report is made up of specific recommendations, which of course we need not follow. As respects clearance, the State law requires 18 ft. clear headway above the track, to which must be added 1½ ft. for the floor, making 19½ ft., while 12 to 14 ft. headway is allowed for under crossing. The Board recommend 13 ft. as a rule. There is one very important contingency in respect to clearance which the Board do not touch upon: the time is now close at hand, and ought to be hastened by legislation, when the introduction of freight-train brakes will make it unnecessary for brakemen to run over the tops of trains, at least between stations. But for this necessity, at least 4 ft. less clearance would suffice; and as it is nearly always highly desirable to reduce the clearance to a minimum, it would seem a pity to continue the extensive construction of over-crossings at a height for which, in a few years, there ought to be no necessity. We recognize the objections to discounting the future in this way, but it would appear as if the time were now near at hand when it might properly be done.

As a whole, the report is a very creditable and important one, and it is greatly to be hoped that the substance of its recommendations will be carried out.

*The Board submit a few facts as to loss of time by the public at crossings, showing that, at current rates for labor, there was lost at one crossing in Lynn, time worth $35 per day; at one in Charlestown, over $50 per day; at one in Roxbury, $12 per day, etc.

The Syracuse Gang-Wells from the Company's Standpoint.

The able report of Mr. J. J. R. CROES on the Syracuse, N. Y., water-supply, elsewhere given, has called out a spicy communication from the Syracuse Water Company in reply to the opinion of MR. CROES on the gang-well experiments.

The company says it has expended $40,000 in making its investigations, that it has called to its aid men of general and practical experience, that its experiments have been closely and scientifically watched and a complete record of daily results was kept. A letter written to Mr. CROES on Jan. 17, and now published by the company, gives a detail of the experiments of September and October last, and differs materially from the results given in the report. The claim is made that these tests prove that the two plants could secure 10,000,000 galls. per day, even in the dryest seasons, with the ground water at the lowest ebb. They say they are ready to execute a contract for the above amount guaranteeing the work for one year, and they are ready to assume the responsibility for and to guarantee an additional or second plant of 10,000,000 galls. daily, without reducing the quantity from the first plant.

As to the charge that the water obtained is too much charged with the sulphate of lime to be useful for manufacturing purposes, the Company says it used 2 new 85 H. P. boilers for 100 days of 10 hours each, in its experiments last fall; that these boilers, when opened and inspected by an official of the city, were found to be in good condition, though they had been forced to their utmost capacity and no attempt had been made to keep them clean by means of compounds or other ingredients used for such purposes. The directors of the Water Company claim that while the water is hard, this hardness comes from the carbonate and not the sulphate of lime; and in support of this they produce the qualitative examination of Prof. LATTIMORE, of Rochester University, who says, "By far the larger portion of the residue consists of the first-named substance (carbonate of lime). The carbonate of magnesia is in much smaller quantities, while the remaining five substances (including sulphate of lime) are present only in very insignificant proportions."

The "hardness" of the water is evidently a ques-

tion upon which the experts cannot agree, as the Company states that Mr. CROES puts it at 42.32 per 100,000 parts, or 25.26 per gallon.

Prof. CHANDLER found the hardness per gallon to be 17.60. Prof. LATTIMORE found 20. Prof. ENGLEHARDT found respectively 17.30, 17.80, and 16.20. He made a number of analyses of the test tubes, the lowest being 15.90, the highest 18.20. Another disagreement among chemists is found in the Cardiff water. Mr. CROES gives its hardness 17.02 per 100,000 parts. Prof. GARDINER, in his report to the State Board of Health, gives the hardness, at the point where it was proposed to build a dam, at 14.37; at the head of the valley at 12.50. Skaneateles lake is quoted at 9.17.

The directors of the Water Company also attack the proposed supply from Skaneateles lake, and claim that in 1886 they themselves proposed to the city to supply water on the Cardiff dam plan. They conclude their lengthy communication by declaring that they feel justified in assuming the following:

1. That the report of the Commission in relation to the gang wells does this company serious injustice in presenting conclusions to the public which the facts do not warrant. On the contrary, the facts, it seems to us, fully substantiate the belief that a very large supply of water can be obtained sufficient for at least 300,000 people.

2. In relation to the hardness and composition of the gang-well water, chemists disagree, the Commission's chemists disagreeing among themselves, the Commission declares. We accept the declaration of the Commission that chemistry is not a safe guide upon which to solely rely for determining the quality of water. Practical tests are without mystery and can be read by any person of intelligence. Practical tests accord with the opinions of the company's chemists, who declared the water quite free of sulphate of lime and as containing far less impurity than any other practical source of supply. Do not the tests at the same time dispute the accuracy of the Commission's chemists?

CORRESPONDENCE.

Yellow vs. Red Fir.

PORTLAND, Ore., Feb. 9, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In a recent number of the Chicago *Railway Review*, a correspondent, in the course of an article on "Wood vs. Iron Bridges," says: "As to the durability of wood, the Superintendent of the Canadian Pacific Railway says, in a paper on the subject, that the Northwestern fir will last 40 years and be perfectly safe."

I am a manufacturer of timber at present, and built that portion of the Northern Pacific Railway between Portland and Puget Sound. On this 150 miles of road there is a very large proportion of trestle and Howe truss bridges. The first part of this road was built in 1871. Within 3 years afterwards I found a great many of the timbers in the Howe truss bridges had decayed, and on examination found they were red fir. I have since noticed that the red fir stick in a bridge will not last more than one-third as long as the yellow fir.

A great many eastern roads are getting, from Oregon and Washington Territory, ties and bridge timbers, and they indiscriminately buy both red and yellow fir; in fact, they make no distinction between these two kinds of timber.

In a short time there will be complaints that our fir timber on the Pacific coast is worthless, because of their failing to buy the *yellow* instead of the *red* fir. The latter will last, as cross ties, at least 8 or 9 years, or as great a length of time as the best white oak; whereas the former will not last more than one-third that time.

I suggest to the railway companies, in buying timber here, that they be careful to have an expert examine this timber, and buy only *yellow* fir. As their habit is now, when they can make a purchase for $2 or $3 a thousand less, they are loaded up with the inferior article in a very large proportion.

In this connection I wish to submit the experience of Captain J. W. WHITE of the U. S. Revenue Marine service. He has superintended the building of all the revenue cutters that have been constructed on the Pacific coast, and he informs me that he never, in a single instance, puts a piece of red fir in the construction of one of the Government vessels.

The following is his letter written to me from Oakland, Cal., under the date of Feb. 2, 1889.

The revenue steamer *Wolcott* was built at this port in 1873, under my supervision, of material obtained at the several lumber yards, but not cut expressly for ship building purposes, nor can I now say whether it came from Oregon or Washington Territory. It was, however, chiefly, if not entirely, of yellow fir that had been then deemed by far the most durable. This vessel was carefully examined and repaired in 1884 under my supervision, the only decayed parts being in the frame of the top sides along the boiler and engines span and about the topgallant forecastle where water had been admitted with no chance to dry out and no ventilation. She has been in commission since 1873, save the few months required to make the above named repairs, and I have no doubt but that she is perfectly sound at this time.

The revenue steamer *Corwin* was built at Portland, Ore., in 1876, under my supervision, entirely of yellow fir. She has been in service since that time cruising from San Diego to the Arctic Ocean, was carefully examined but a few months since by a Board, Capt. HOOPER, an expert shipbuilder, and myself. The only decayed timber found was in one timber forward and above the main deck line and under side of plank on spar or quarter-deck, both being from leakage and no chance to dry.

The revenue steamer *Rush* was built at Port Blakeley, Washington Territory, in 1885, under my supervision, also of yellow fir.

Both the *Corwin* and *Rush*, when built, if in the merchant service, would have been rated 3-3, which is the highest class for 13 years. The *Corwin* having reached that age, from the inspection above referred to, her condition entitles her to the same rate for five years more without further inspection, and I feel assured the *Rush* will prove quite as sound when she has reached a similar age. Time has shown that the *Wolcott* would also have borne a first-class rating; though, as above stated, the material of which she was constructed was not cut especially for ship building purposes.

For fence posts or railroad ties, select the butts of large yellow fir trees, say 16 ft. up; let the sap be well dried out before placing them in position. I will venture to say that a large majority of them will be sound at the expiration of 15 years, while the life of the red fir will not be over 3 years. No disinterested person can say less for the one and more for the other knowingly.

In conclusion, I wish to say that the strength of the yellow fir as a bridge timber is not excelled even by the oak of the Eastern States. That has been demonstrated by the experiment made at the Mare Island Navy Yard in California. For railway ties it is fully as valuable as oak, and will hold a spike much longer.

Yours respectfully,
J. B. MONTGOMERY.

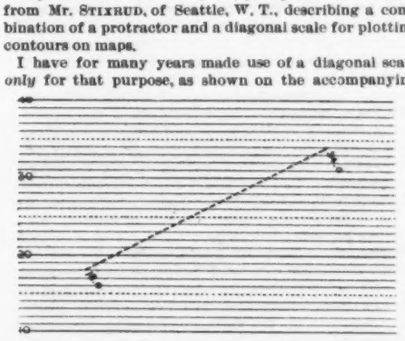
Plotting Contours.

YONKERS, N. Y., Jan. 7, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In your issue of Dec. 15, 1888, you published a letter from Mr. STIXRUD, of Seattle, W. T., describing a combination of a protractor and a diagonal scale for plotting contours on maps.

I have for many years made use of a diagonal scale *only* for that purpose, as shown on the accompanying



cut, and thinking it may interest some of your readers I will endeavor to describe the scale and the manner of using it, as I believe there can be no more expeditious method of plotting contours than the following:

The scale consists merely of parallel equidistant lines, drawn on tracing paper or cloth, as on the accompanying cut, the lines being from 1-40 in. to 1-10 in. apart, to suit the purpose of the person who uses the scale. It is only necessary that they be equidistant. The single oblique line (which is supposed to be seen through the transparent sheet on which are the parallel lines) shows the manner of using the scale.

If it is required to find where the 20, 25, and 30 ft. contours cross a line whose ends are at elevations of 18 and 34 ft. respectively, we can assume that the first heavy line of the scale is numbered 10 ft. Then laying the scale over the line on map, we cover the end corresponding to the 18-ft. elevation with the 18-ft. line of the scale. Then swinging the scale around on that point, we next cover the other end of the line on the map with the 34-ft. line of the scale. It is then a very easy matter to mark the points where the 20, 25, and 30 ft. contours cross the line under the scale, by using a needle-point. A large piece of the transparent material can be ruled and cut into strips, thus making a number of scales ready for use. A strip will last several months, even if used daily.

M. LORINI.

[This method is new to us, and strikes us as very meritorious and ingenious, although—or rather, because—extremely simple—ED. ENG. NEWS.]

Brass Tapes.

BOSTON, Mass., Feb. 5, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

I have read with interest what you have published in the last few issues in regard to brass tapes, and would say, for the benefit of those desiring to obtain them, that those used in laying out the Back Bay district, referred to in your issue of Jan. 12, were obtained of Messrs. J. A. GOWNEY & SON, Providence, R. I. They probably still furnish them, or rather the rolled brass ribbon, for about $3 for 104 ft. of the plain tape. These tapes are ¼ to 5-16-in. wide, and perhaps 1-170-in. thick. The best box or reel is that shown on page 32 of your journal. The tapes used on the Back Bay were graduated from a standard obtained from the Coast Survey.

From this standard a 10-ft. rod was made, and the brass ribbon clamped to either end of it, after being drawn taut. The tape being parallel to the edge of the rod, a small try square or T square and a quill pen [gold pen is better.—ED.] afforded all the instruments necessary for marking. Bichloride of platinum, obtainable of almost any druggist, was used for marking. It was usual to clean the tape of oil and dirt, at the place where the figures were to be marked, by slipping a piece of thick brown paper or cardboard under the tape, between it and the rod, and rubbing the tape bright with crocus cloth or very fine emery cloth.

Any scratching of the tape is not recommended, for the reason that it would be liable to cause the tape to break at that place, and also that when the tape is re-marked, the scratch will not be in the right place.

If the bi-chloride is too strong, dilute it with a little water. A little practice will enable one to make the cross-mark of the right width. The figures designating the feet above 9 were usually placed one on either side of the foot-mark. Oftentimes, after the tape was dry, the tape at the foot-marks would be held near a gas flame and slightly warmed, and then a little white shellac brushed over the figures. This somewhat prevented the numbers from being worn off.

The tape was often graduated to 102 or more feet according to the length of ribbon.

A "minus foot," as has been explained, was marked to hundredths of a foot, but only the tenths were figured. This foot was of course on one side of the zero, and the whole foot-marks on the other.

The tape was put into the box at the 100-ft. end and a string tied into a loop at the other. The string wound around the end of the tape so enlarges it as to wedge it between the sides of the box and thus prevent it from unwinding.

The tape was held at the box end, upon the point to be measured from, the foot-mark coinciding exactly with the point or line to be measured from.

The fraction was read by the person at the other end, and his orders were to "take up one" or "let out one," till the point to be measured to, came within the range of the "minus foot."

One great advantage of the tape was its cheapness. Another was the having a definite line on the tape to place upon the line or point to be measured from, which is not the case when some part of a ring is to be held to a mark in careful measuring. A third advantage was that the tape did not rust, and it could be wound up without careful cleaning in wet and muddy weather, although it was of course desirable to clean or wipe it on getting into the office. Another advantage was that the tapes were rarely broken.

The writer was connected with the Back Bay work under Professor HENCK, and can bear testimony to the admirable way in which that work was planned and carried out. All measurements were made with brass tapes and a spring balance and thermometer used.

A cloudy day was usually selected, as the temperature was more uniform; and where there were buildings, part of the tape would not be in the sun and part in the shadow.

Where streets were graded but no curbstone had been set, a row of stout stakes were put in on the curb line, about 100 ft. apart. Nails were put in the stakes; if there were curbstones set, nails were put in the joints. A series of measurements were taken between these nails. The difference would generally be but a few thousandths of a foot. From the mean of these measurements, corrected for temperature and for difference of level, the stations of the different nails were determined for future use. The point of beginning was a nail whose station was known.

The correction for difference of level or slope was by the simple rule, original with Professor HENCK, I think, "Square the height and divide by twice the slope."

This is obtained by taking two terms of the expression

$$a = \sqrt{b^2 - c^2}$$

where b is the distance measured on an inclination or slope, c the difference in level, and a the horizontal distance required.

In the expression above, we find $a = b - \frac{c^2}{2b}$ etc. When c is small compared with a or b, the third term is too small to be considered. This approximate rule gives results near enough till a rise of 10 ft. in 100 is reached, as the following table will show:

	Correction by Approximate Rule.	True Correction.
.1 in 100 =	.00005	.00005
.5 " "	.0012	.0012
1. " "	.005	.0051
2. " "	.020	.0201
3. " "	.045	.0451
4. " "	.080	.0801
5. " "	.125	
6. " "	.180	
8. " "	.320	
9. " "	.405	
10. " "	.500	.5013
11. " "	.605	.6063
12. " "	.720	.7209

This rule is of course equally applicable in laying off a given distance on an inclined surface. It is easily remembered and quickly applied, and will be found very useful to all having exact measurements to make.

The objections to the brass tape are: The time and labor required to mark it; that it is liable to kink, and the first 50 ft. is, after some use, full of short bends, which reduce the length; in wiping off mud, and in dragging it on the ground, the figures are quite soon worn off. After having been re-marked once or twice, the marking requires frequent renewing, and the time required increases as the tape becomes kinked and twisted.

The writer, after experience with both brass and steel tapes, prefers the latter, and believes if the time of remarking is taken into account, the latter are cheaper. They are certainly much more compact to use and carry.

The objection to a steel tape is its liability to break and to rust. With good care a tape will last 3 or 4 years, which is not true of a brass tape, although both have to be frequently repaired.

The number of brass tapes used in Boston is probably small, the Chesterman steel tape being the most common.

If a man had only occasional use for an accurate tape, a brass one would perhaps answer his purpose.

Yours very truly,
F. L. FULLER.

[Our correspondent's view of the comparative value of brass and steel tapes differs from our own, each being based on practically the same experience. He seems, we admit, to have the majority on his side, and the majority is apt to be right on a question like this, which depends purely on the actual results of experience. The rule for solving small triangles we have often given in these columns, and it is of the greatest use and merit, not only for correcting measurements but for many other purposes. —ED. ENG. NEWS.]

Column Formulæ.

PITTSBURG, Pa., Feb. 14, 1889.

TO THE EDITOR ENGINEERING NEWS:—

In your issue of Feb. 9, Prof. GREENLEAF takes me to task for claiming a scientific basis for my column formula, which he thinks it does not deserve. He concedes, however, that I am "practically right," though "theoretically wrong."

His difficulty seems to lie in a too tenacious adherence to TREDGOLD'S hypothesis, and in what seems to me an erroneous view of what constitutes "work."

TREDGOLD'S assumption that the material in a column is subjected to a direct compression equal to the load, and in addition thereto, to the bending stresses due to flexure, has formed the basis of all attempts to solve this problem, and they have invariably led to equations of the form of GORDON'S. Indeed, starting from that hypothesis, no other form of equation is possible. Hence the line representing any formula based on it must inevitably show the characteristic reversed curvature due to that form of equation.

Furthermore, EULER'S equation is based on the entirely different assumption that somewhere, as the length increases, the direct compression disappears, and the load is supported wholly by the elastic reaction in flexure.

These two hypotheses are antagonistic and cannot both be true. If the platted experiments sustain one, the other necessarily falls to the ground. They not only confirm EULER'S, but, by the absence of the reversed curve, furnish direct evidence that TREDGOLD is wrong.

Notwithstanding the direct evidence of error afforded by that array of facts, Prof. GREENLEAF still adheres to the old hypothesis, and thinks that the bow, used for illustration, sustains a compression throughout its length equal to the tension in the string, *in addition* to the bending stress due to flexure. Now the reaction due to flexure is alike at both ends of the bow, and when the string is replaced with an equal external load, and a support, this elastic reaction exerts a pressure on the point of support which will also equal the imposed load. According to TREDGOLD, another equal amount of pressure will also be applied to the support by direct transmission, and we will thus have the point of support receiving a pressure equal to *twice* the load supported—a proposition which refutes itself.

Considering, then, that EULER'S hypothesis is established, not only by the experiments, but by theory as exemplified in the bow, it follows that the true hypothesis must be one which permits the direct compression to become zero, when the elastic reaction becomes equal to the load; and I suggested that such an hypothesis would be had if we assume that when the reaction due to flexure is less than the imposed load, it supports just that much of the load; and the residue only is transmitted by direct compression. In support of this suggestion, I pointed out that it is in harmony with the principle of the conservation of energy, while TREDGOLD'S is not. This Prof. GREENLEAF thinks is a wrong application of that principle.

I think, however, that he errs in associating the idea of "work" with that of "motion" only. If motion be prevented, then the work expended takes the form of *stress* in the resisting medium; and the amount of stress developed is proportional to the energy expended. The principle applies just the same whether motion is arrested before it has begun, or after. The man who keeps a hundredweight from falling, no doubt thinks he works as hard as the man who picks it up.

The professor finds it difficult to believe "that columns obey the law of the straight line to a certain point and then suddenly run into EULER'S curve." But if one element of resistance disappears at that point, why should not the line change its forms? Up to that certain point the line will be either straight or curved according as the combined resistances to flexure and compression vary as the *first*, or some other power of the length. The experiments show that the line is straight, and hence we know that the equation for it must contain only the first power of the length. Beyond that point, where the direct compression disappears, the resistance is wholly one of flexure, which varies as the *square* of the length, and hence that portion is curved. I can see no reason why the equations of a curve and its tangent should not be interchangeable at the point of tangency without the aid of a "transition curve." Whatever may be said for or against easement curves in railroad tracks, they are not essential in analytical geometry.

"From the standpoint of pure theory," it is to be observed that when the resistance is wholly one of flexure it varies as l^3, and when it is one of compression alone, it is independent of the length, or (to be more mathematical) it varies as l^0. When both forms of resistance are combined, it is reasonable to suppose that the total resistance will vary at some rate intermediate between l^0 and l^3. The mean between 0 and 2 is 1. Hence "pure theory" leads us direct to the straight line conditions.

The whole matter may be summed up thus:

First. The experiments clearly prove that TREDGOLD'S hypothesis is erroneous.

Second. The principle of the conservation of energy affords the clue to the source of that error, and furnishes a new hypothesis in harmony with the experiments.

Third. The experiments confirm EULER'S equation, and establish the tangent to his curve as the true exponent of the law sought.

Fourth. All reasoning based on scientific principles, other than TREDGOLD'S hypothesis, while not demonstrating, strongly confirm the experimental deductions.

I fully recognize that the new formula is purely empirical in its origin; but it so thoroughly accords with *all* the experiments, that any theory which combats it must antagonize facts, and suffer accordingly. So far as scientific reasoning on this subject can now be carried, there are strong grounds for believing that a correct scientific deduction will confirm the empirical one. To this extent only do I claim a scientific basis. What I do claim, and what my former communication was especially intended to show, is that TREDGOLD'S hypothesis is completely disproven by the facts, as well as by theoretical considerations, and, therefore, the new formula, which agrees both with facts and theory, is entitled to the greater credence, as being much nearer to the scientific truth than any other formula that has, as yet, been proposed.

THOS. H. JOHNSON,
P. A. Engr. P. C. St. L. R. R.

[Most of the Engineering Societies have by-laws forbidding the publication of papers "controverting established facts." To our mind, Mr. JOHNSON'S general theory may properly be included under this head, and we cannot publish anything further on the subject unless it shall contain matter to cause us to change our conviction.—ED. ENG. NEWS.]

Making Topographical Relief Maps.

University of California,
BERKELEY, Cal., Feb. 5, 1889.

TO THE EDITOR ENGINEERING NEWS:

The photograph herewith enclosed may be of interest to you and your readers. It is of a plaster model of the site of the University of California, in Berkeley.

The model was made by students in the College of Civil Engineering, as an exercise in mapping. The area represented is about 200 acres, and lies at the foot of the Contra Costa hills—a portion of the Coast Range of California. As is seen from the model, the irregularity of contour within the university grounds is considerable, making the tract an almost ideal field for the landscape gardener. As yet comparatively little has been done in the way of beautifying the site, and this neglect is largely due to insufficient water supply. It is hoped this difficulty will be soon removed.

The buildings are about 3 miles inland from the easterly shore of the Bay of San Francisco, just opposite the Golden Gate, and being at an elevation of about 300 ft., 100 ft. of it within the university grounds, command an uninterrupted view of the Bay and its islands and the surrounding mountains.

The difference in elevation between the highest and lowest points in the grounds is about 700 ft.

The model was made in the following way: A careful topographical survey of the entire tract was made and 10-ft. contours accurately drawn. These contours were then transferred in pairs to sheets of bristol board of the proper thickness to give the required scale, there being no exaggeration of vertical scale. Each sheet was then cut to the line of the lower contour drawn on it with a scroll saw. The upper contour line on the first or lowest sheet was the same as the lower contour of the second sheet. The second sheet was properly placed on the first sheet by bringing its cut edge to the line of the upper contour on the first sheet and it was then tacked to the lower sheet. The third sheet was similarly placed on the second and so on to the top. The "steps" thus formed were filled with a mixture of beeswax, turpentine, Venetian red, cornstarch, and sweet-oil applied hot and smoothed down. The writer used the mixture as prepared by Mr. O. B. HARDEN, of Philadelphia, the proportions being given in Haupt's "Topographer," but found difficulty in spreading the mixture, and recommends a softer substance where smoothness is desired, and there is much detail to be represented. A box was then put together with screws and made to fit the paper and wax model in length and breadth and about 2 ins. deeper than the highest part of the model. In this box the model was placed, and both the model and the sides of the box well oiled with sweet-oil applied with a brush.

Ordinary commercial plaster of Paris was then mixed with water to the consistency of thick cream, and poured into the box until it was full. The box was then slightly raised, and dropped, to cause any bubbles that might be formed in the plaster to rise to the top. The plaster began to set at once, and in 3 or 4 minutes became of the consistency of thick mush, when a straight edge was passed over the top to make the surface, or rather bottom, of the model perfectly flat. In order to facilitate drying and to make the cast lighter, some of the plaster may be scooped out of the thicker parts of the cast, care being taken not to disturb the surface next the model. In from 5 minutes to half an hour, depending on the thickness, the cast will be hard enough to remove. It is usually hard enough just after it gets warm. To remove it, a board was placed over the top of the box and the box carefully turned upside down; the bottom and sides were then taken apart, and the paper and wax model carefully removed from the cast. We now had a plaster negative. This required several weeks to thoroughly dry. After it had become dry, it was covered with two coats of white shellac and placed in the box before used and its surface and the sides of the box oiled. Plaster was then poured as before, and the result was a plaster positive.

This positive was allowed some weeks to dry, and then it received two coats of white shellac, and was ornamented with suitable topographical signs, and the buildings, walks and roads, etc., platted in with pen and India ink. It then received another coat of shellac, and was finished. It is fairly accurate, the scale of the model being $\frac{1}{2000}$ both horizontal and vertical, while the scale of the photograph is $\frac{1}{2500}$.

W. S. R.

PERSONAL.

Mr. JOHN B. HEIM, Superintendent of Water-Works, Madison, Wis., has resigned.

Mr. SAMUEL M. STEVENS has been appointed Superintendent of the water-works at Defiance, O.

Mr. AMOS L. HOPKINS, Second Vice-President of the Missouri Pacific, has resigned, and the position has been abolished.

Mr. W. G. BRIMSON, formerly a train dispatcher on the Lake Erie & Western, has been appointed a Division Superintendent on the Northern Pacific.

Mr. JOHN S. LENTZ, Master Car Builder of the Lehigh Valley Ry., with headquarters at South Bethlehem, Pa., has had his title changed to that of Superintendent of the Car Department.

Mr. JAMES T. MOORE, of Louisville, Ky., has been appointed president of the Kentucky & Indiana Bridge Co. Mr. CHAS. WEAVER, of Louisville, has been appointed Secretary.

Mr. W. B. STOUT, bridge contractor, while doing some work for the Fremont, Elkhorn & Missouri Valley Ry. Co. near Norfolk, Neb., was struck by a falling timber and killed, on Feb. 11.

Mr. OSGOOD, Chief Engineer of the Lake Shore & Michigan Southern, will resign on March 1. He will continue as Consulting Engineer of the Toledo, St. Louis & Kansas City, a position which he has retained since his resignation as Chief Engineer of that road in January, 1888. Mr. GEORGE H. KIMBALL, formerly Supt. E. Div., N. Y. C. & St. L. Ry., succeeds him.

Mr. S. R. AINSLIE has succeeded Mr. J. M. BUCKLEY as General Superintendent of the Northern Pacific, with headquarters at St. Paul. The three grand divisions, and also the titles of Assistant General Managers, are discontinued. The jurisdiction of Mr. AINSLIE extends over the entire main line and branches.

Mr. JOHN H. CONVERSE, of the firm of Burnham, Parry, Williams & Co., proprietors of the Baldwin Locomotive Works, has perfected arrangements for the erection of a building to be given by him to the Presbyterian Hospital at a cost of $70,000; to be called the Administration building.

Mr. C. R. KNIGHT is now chief engineer of the Jacksonville, Tampa & Key West Railway system with office at Jacksonville. His appointment took effect Feb. 1.

THE Ohio State Board of Public Works has appointed the following superintendents of canals: Miami and Erie: HOMER MEACHEM, JOHN O'CONNOR, and C. W. SUTPHIN, Jr. Ohio Canal,— Grand Division No. 1.: A. W. HALL, Akron; GEORGE HILL, Roscoe; WILLIAM HAHN, Zanesville. Grand Division No. 2.: A. MILLER, Logan; C. A. GODARD, Franklin Furnace.

Mr. S. H. H. CLARK, First Vice-President and General Manager of the Missouri Pacific, will, it is said, retire from active railway service March 1 on account of ill-health. Mr. CLARK has been General Manager of the Missouri Pacific since November, 1886. For many years previous to that time he was General Manager of the Union Pacific.

THE Boston Water Board adopted resolutions recently that after Feb. 21 the office of Superintendent of Meters be abolished, and the meter service be merged into the Eastern and Mystic Division of the Water Board, that the force be reduced to 11 men, and that WILLIAM J. WELCH, hitherto Superintendent of the Meter Division, be transferred to be Assistant Superintendent of the Mystic Division, in place of J. S. CANNON, who is transferred to the inspectorship of the whole water department.

Mr. E. L. CORTHELL, M. Am. Soc. C. E., is evidently one of the very busy civil engineers of these days. With Mr. MORISON, he is Chief Engineer of the Merchants Bridge at St. Louis, is Engineer of the proposed New Orleans bridge, has in charge the Brazos river improvement in Texas, is examining an inside Florida waterway of 350 miles from St. Augustine to Biscayne Bay, is interested in the belt line of railways in New Orleans, etc. And in the last year Messrs. MORISON & CORTHELL have completed a bridge over the Willamette, at Portland, Oregon; another over the Missouri at Sioux City, and a third at Nebraska City.

Mr. FREDERIC H. ROBINSON, the present Chief Engineer of Wilmington, Del., is a Republican, and there is a movement on the part of some Democratic members of Council to drag his office into party politics by applying the rules of ordinary political preferment to the selection of a new engineer. This action has brought out a protest, signed by many of the most prominent citizens and business men of Wilmington, of both parties, who recommend the reappointment of Mr. ROBINSON on account of his satisfactory record, efficiency, acknowledged qualifications, and familiarity with the duties of his position.

Mr. N. D. ROOT, Assistant General Superintendent of the Northern Pacific, who was recently injured at Tacoma, Wash. Ty., died at St. Paul, Minn., Feb. 14. Mr. ROOT was born in the State of New York, and was 39 years of age. He began railroading in 1864 as telegraph operator for the Chicago & Northwestern at Council Bluffs, Ia., and was afterwards train despatcher for the Chicago, Burlington & Quincy, in Iowa, going from there to Jackson, Mich., as chief train dispatcher for the Michigan Central. He left the Michigan Central in 1881, and accepted the post of trainmaster and chief train dispatcher at Brainerd, of the Minnesota and St. Paul divisions of the Northern Pacific. He was subsequently promoted to Assistant Superintendent of these divisions. When Mr. AINSLIE was made Superintendent of the Minnesota and St. Paul divisions Mr. ROOT succeeded him as Superintendent of the Yellowstone division, with headquarters at Livingston, and in October, 1887, again succeeded Mr. AINSLIE when the latter was made Assistant General Manager, Dec. 15, 1888. Mr. ROOT became Assistant General Manager of the middle grand division, with headquarters at Helena. On Feb. 1, 1889, when the grand divisions and offices were abolished, Mr. ROOT was made Assistant General Superintendent, with headquarters at Helena, and when injured at Tacoma he was on his first tour of inspection.

PUBLICATIONS RECEIVED.

—*Eleventh Annual Report of the Board of Railroad Commissioners of the State of Iowa*, for the year ending June 30, 1888. PETER A. DEY, SPENCER SMITH, FRANK P. CAMPBELL, Commissioners. 6 x 9 ins., 869 pp., cloth bound. Published by the State.

Unusual interest attaches to this volume because of the work which the Iowa Commission has undertaken in the regulation of railway rates. The Commission present their side of the controversy and certainly deserve an impartial hearing. We will publish a review of their report in an early issue.

—*Challen's Engineers' Log-Book*. 3¾ x 9 ins. Flexible covers, 75 cts.; half roan, $1. Publisher, HOWARD CHALLEN, 150 Nassau St., New York.

This is a log-book for steam engineers, and is composed of blank forms for a record of the daily run of an engine for 1 year, 1 week on each page. The tabular form covers one page, and the opposite page is left blank for notes and remarks. Such a log-book, carefully kept, would give a very interesting record of engine performance.

The Weather of the United States for the Month of January, 1889.

[As respects the elements of most interest to engineers.]

According to special returns from the Chief Signal Officer of the U. S. Army.

STATIONS.	Temperature. Degrees Fah.				Wind velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average.	Max.	Direction at time of Max. Vel.	Total.	Heaviest in 24 hours.	No. rainy days
Northern Cities.										
Northfield, Vt.	22.7	57.	—10	67.0	8.4	48	SW	3.90	1.14	17
Portland, Me.	28.4	52.	6.4	45.6	9.2	47	SE	3.47	1.04	11
New York City	36.2	58.	17.4	40.6	12.8	50	SE	5.38	1.87	11
Pittsburg, Pa.	35.2	61.	16.7	44.3	6.6	32	SW	2.50	0.74	14
Chicago, Ill.	28.4	55.	Zero	55.0	10.5	44	SW	1.64	0.68	5
Omaha, Neb.	22.8	47.	—2.5	49.5	8.3	38	NW	1.62	0.78	7
St. Paul, Minn.	18.1	42.	—10	52.0	6.0	26	NW	0.55	0.27	10
Duluth, Minn.	18.8	45.	—12.7	57.7	6.4	34	SW & NW	1.54	0.56	23
Bismarck, Dak.	13.8	46.	—18	64.0	9.6	48	NW	0.50	0.18	12
Average	24.9	51.4	—1.4	52.8	8.5	40.8		2.32	0.81	11.1
Southern Cities.										
Washington City	37.0	66.	23.	43.0	5.0	26	NW	4.05	1.26	11
Louisville, Ky.	38.1	60.	17.	43.0	8.4	40	SW	3.07	1.28	13
St. Louis, Mo.	33.7	63.8	13.	50.8	11.1	48	W & NW	3.04	1.31	8
Savannah, Ga.	50.	69.4	28.6	40.8	7.1	30	W	6.36	1.98	14
Leavenworth, Kan.	27.6	52.2	3.7	48.5	6.5	26	NW	1.66	0.68	7
Jacksonville, Fla.	53.8	74.0	31.	43.0	6.0	35	SE	5.89	1.99	14
Chattanooga, Tenn.	40.8	64.2	19.8	44.4	5.7	40	W	5.31	1.22	15
New Orleans, La.	51.5	75.	34.	41.0	9.4	36	SE	6.51	1.23	15
Memphis, Tenn.	41.6	65	21.3	43.7	5.4	30	NW	5.28	2.06	11
Palestine, Tex.	47.1	70.2	24.6	45.6	6.3	30	W	6.82	1.69	16
Average	42.1	66.0	21.9	44.4	7.1	34.1		4.74	1.47	12.4
Western Cities.										
Helena, Mont.	15.0	48	—13.6	61.6	3.6	36	W	0.42	0.22	5
Port Angeles, W. T.	35.6	50.2	26.	24.2	3.8	24	S	2.96	0.92	17
San Francisco, Cal.	49.2	64.3	40.4	23.9	5.0	36	NE	1.28	0.81	7
Salt Lake City, U.	21.1	44.	5.	39.0	3.0	18	SE	0.73	0.20	6
Denver, Col.	23.8	56.	4.	52.0	6.4	36	N	0.50	0.20	8
Yuma, Ariz.	53.0	71.6	35.1	36.5	7.6	35	N	1.12	1.06	3
Santa Fé, N.M.	22.4	46.0	Zero	46.0	5.9	36	SE	0.84	0.26	9
Average	31.4	54.3	13.8	40.5	5.0	31.6		1.12	0.52	7.7

—*Report of the Bureau of Statistics on Foreign Commerce and Navigation, Immigration and Tonnage of the United States*, for the year ending June 30, 1888. Pub. Doc.

This is an enlarged edition in cloth of the pamphlet report we recently reviewed, containing still fuller statistics.

—*The Gradual Abolition of the Crossing of Highways by Railroads at Grade.* Report of an investigation by order of Legislature of Massachusetts by AUGUSTUS W. LOCKE, WM. O. WEBER, GEO. A. KIMBALL, Engineers. Pub. Doc. pp. 76. Numerous plates, maps and views.

We review this valuable report editorially in this issue, and therefore do not here notice its contents further.

BOOK REVIEWS.

Development of Transportation Systems in the United States, comprising a comprehensive description of the leading features of advancement, from the colonial era to the present time, in water channels, roads, turnpikes, canals, railways, vessels, vehicles, cars and locomotives; the cost of transportation at various periods and places, by the different methods; the financial, engineering, mechanical, governmental, and popular questions that have arisen; and notable incidents in railway history, construction and operation. By J. L. RINGWALT, editor of the *Railway World*. Philadelphia. Published by the Author, Railway World Office. Imp. 4to. pp. 445, 48 full-page plates. $5.00.

It would hardly be possible to put together 445 quarto pages relating to a single subject and not include in it a good deal of information which is likely at some time or other to be valuable to those interested in the subject. Such value as this imposing work may be supposed to have from this point of view may be freely accorded it; but measuring it by the usual standard for new technical publications, that they are to convey new or newly collated information upon some alleged subject, this is one of the trashiest and most worthless volumes which it has ever become our duty to notice.

Its illustrations at once give the key-note to it to the discerning reader,—and we wish we could feel justified in reproducing one of them, to save ourselves the trouble of further review. Suffice it to say that they resemble for the most part rough charcoal sketches of such subjects as "The dangerous ford," "The tardy ferry," "Rural wooden bridge," "Primitive drawbridge," etc., rarely representing an actual object of historic interest, and when they do, giving only the rudest outlines of it. Very often the views do not even truly represent, however rudely, what they purport to represent, as in the absurd sketch on page 224, purporting to give the outlines of that beautiful structure, the old wooden Genesee High Bridge. It is no exaggeration to say that any good carpenter who had never seen that trestle or any other, nor heard it described, ought to be able to make off-hand a sketch bearing a closer resemblance to the probable original than does this.

As the pictures are, the text is—vague, discursive, wandering, inaccurate, and sloppy. Most of the statistical facts have been taken from the Census, the Bureau of Transportation Reports, Poor's Manual, and other such easily accessible publications, in some important cases without acknowledgement, and always with sublime indifference as to whether the information quoted was down to date or not. Thus, in this volume, issued in 1889, not only many but most of the tables end in 1880, 1881, 1882, 1883, and 1884, nearly all of them having been since carried down to date in subsequent issues of the same publications, had the author chosen to take the trouble to hunt them out. The most amazing case of outright appropriation is probably the 1880 census table of railway construction by single roads and years, which is split up into decades and put forward without credit (so far as we can discover) as a result of original investigation.

Occasionally there is a bit of information which strike the reader as new and interesting, but if he will turn to the "Transportation" volume of the last census he will find that most of it has come from there, sometimes with credit, sometimes not. Thus, we take from page 45 some interesting facts as to canals taken from and credited to the census, which have been often heretofore printed, but will bear repetition, and perhaps leave our readers some solid residuum of benefit, besides a warning not to waste their money, from this review. "There has been in all the large amount of 4,468 miles of canal built in the United States, at a cost of $214,042,000, nearly all of it before 1840, when we had only 2,818 miles of railway in operation. Of this 4,468 miles, 1,953, or nearly half of it, has been abandoned; 356 miles in New York, 447 miles in Pennsylvania, 205 miles in Ohio, and 379 miles in Indiana. The 2,515 miles which remain are in 15 States, New York having 608 miles, Pennsylvania 529, New Jersey 171, Maryland 104, Illinois 102, and Ohio most of all, 674 miles. These canals had cost $170,000,000, and earned in 1880 only $4,538,620 gross or $1,584,464 net, nearly all the profit accruing in Pennsylvania and New Jersey, the other canals barely meeting running expenses."

With this bit of definite information about a past great interest we close this notice, which we should not have made at all except that the volume seemed to us preëminently one of the kind that was likely to be offered by subscription, and a certain protection seemed due the public against the wiles of the persuasive book-agent.

SOCIETY PROCEEDINGS.

The Master Builders' Association.—The annual convention was held last week at Philadelphia. The Committee on Uniform Contracts reported what is known as the "standard contract," made by agreement with the American Institute of Architects and the Western As-

sociation of Architects. Attempts were made to have it amended, but the chair decided that as it was the work of a joint conference, the builders could not alter it. The form as presented was then approved and all builders recommended to use it. President JOHN S. STEVENS, of Philadelphia, in his annual address, discussed the uniform contract. While the association does not claim to have a perfect contract, yet this one, he said, is far in advance of any that has been used heretofore in establishing equitably the duties and responsibilities of owners, architects, and contractors. It is to-day largely in use throughout the United States in the offices of many leading architects.

The Association of Civil Engineers, Dallas, Texas, was organized Jan. 12, at Dallas, with constitution limiting degrees to members only, and membership to Dallas and vicinity, the objects of the Association being similar to those of the Engineers' Clubs of St. Louis and Kansas City. This Association is the first permanent organization of engineers to be perfected in Texas, only one effort at organization, a State society, having been attempted at San Antonio, two or three years ago. The officers of the Association for the year 1889 are as follows: President, W. J. SHERMAN; Vice-President, H. S. WATHEN; Director, R. W. HAMUS; Librarian, L. S. LIVERSEDGE; Secretary and Treasurer, E. K. SMOOT. Regular meetings occur on the first Saturday of each month.

Am. Ry. Master Mechanics' Association.—The next annual convention will be held at Niagara Falls, beginning Tuesday, June 18, headquarters at the International Hotel, $3 per day. The following circulars have been issued:

Boiler Covering.—Best method and material to prevent radiation of heat. 1. What form of boiler covering do you consider best? 2. Give reasons. 3. If you use asbestos or other composite covering, how does it compare with wood in first cost and maintenance? 4. Does that composite covering cause corrosion of sheets or jacketing? 5. Does it inconveniently interfere with examination of boilers? 6. How is it put on? 7. Please give estimate of comparative value of wood and composite boiler covering as preventive of heat radiation. 8. Any other information. Send replies to G. W. STEVENS, Supt. Motive Power, L. S. & M. S. Ry., Cleveland, O.

Driver-Brakes, etc.—1. How many locomotives of each class, viz., passenger, freight, and switching, have you equipped with driver-brakes? 2. How many are operated by compressed air, by vacuum, and by steam? Which gives the best results, and why? 3. Number of engines of each class equipped with each style of brake, viz., the *spread*, the *pull*, and the *clasp*. Which gives the best results, and why? 4. Are brake-shoes applied to *all* the driving wheels? If not, please say in what respect and to what extent devintion from this practice is followed, and if unsatisfactory wear of tires has resulted. 5. From your experience, under what circumstances do you recommend the use of the driver-brake in conjunction with train-brake? Do you consider the driver-brake should be used in making every stop, or for emergencies only? 6. Do you consider the braking of engine truck wheels to be of sufficient importance to warrant the additional cost of equipment and maintenance? 7. With what different brake-shoes have you had experience? which do you recommend, and why? Please send drawing of same. 8. Results of any experments showing the relative endurance of various kinds of brake-shoes, under similar conditions, also the effect of same on tires. 9. What ratio do you recommend between pressure of brake-shoe on tire and pressure of tire on rail? 10. What ratio do you recommend between pressure in pounds on each brake-shoe and the number of square inches of shoe in frictional contact with the tire? 11. How many engines of each class are there on your railroad equipped with the water-brake? 12. What is average cost of necessary material and labor fitting up this brake? Please supply blue print showing general arrangement of same. 13. Under what circumstances do you recommend the use of this device? 14 Have any unsatisfactory effects upon machinery resulted from the use of this brake? and, if so, how can they be obviated? 15. Any other information. Send replies to MR. CHARLES BLACKWELL, Engr. of Machinery, Central R. R. of Georgia, Savannah, Ga.

Best Proportion of Flue and Grate Area in Locomotives.—The substance of the inquiries (the circular being too long to quote in full, and being obtainable from the Secretary) are: 1. Any change in size and arrangements of tubes, and results therefrom. 2. Any change in size of tubes only, retaining same heating surface. 3. Any change in length only, same area. 4. Any instance where reducing flue area has improved efficiency. 5. Any change in grate area and result. 6. Practice in proportioning boilers and ratios used. 7. Can a locomotive boiler be given too much grate surface? 8. Use of dead plate or drop plate and results. 9. Any improvement by reducing total grate surface? 10. Experiments tending to prove that rapid combustion is preferable to slow, and by how much? 11. Present limit to lbs. per sq. ft. of grate of coal burned. 12. Is this limit likely to be exceeded? 13. Evaporation per lb. coal. 14. Minimum flue area per sq. ft. of grate. Replies should be sent to J. DAVIS BARNETT, Grand Trunk Ry., Stratford, Ont.

New England Railroad Club.—At the meeting, on Feb. 14, the subject of "Steam Couplings for Passenger Cars" was taken up for discussion.

MR. F. D. ADAMS said: Steam heating is a matter of much interest to the railroads. I think it has become a fixed fact that we have got to use some kind of steam heat. That is hardly questioned now, although steam heating was regarded with much disfavor when the subject was first broached. The matter of coupling cars and the conveying of the steam from the engine to the rear of the train, is perhaps the most important part of the system. There is no doubt an honest difference of opinion between mechanics as to the practicability and advantages of the couplers that have been presented for use. Our road is using the coupler that was attached to the heating system we have adopted, and we have had tolerable success with it. The only complaint that we have heard about our cars is that they are too warm. The difficulty with many systems seems to be to regulate the heat properly.

MR. TYLER read the following letter from JAS. MACBETH, Master Mechanic of the Buffalo division of the West Shore:

EAST BUFFALO, N. Y., Feb. 8, 1889.

WILLARD C. TYLER, Esq.

All trains on the N. Y. C. & H. R. R. R. and West Shore R. R. are at present date heated by steam, and we have yet to find one instance where it has made any material drain on the engine. Furthermore, I have received no reports of cars being uncomfortable in carrying the pressure required to heat the cars. Provided the trainmen use good judgment in circulating the steam through the cars, and thoroughly understand the use and working of the same, and that the couplings are uniform and with no excessive leaks, I have yet to find a case where the engine has not been sufficient to meet the demand. We find the runs made for water are not quite so long as before using the steam heat, owing to the increased evaporation of water, this, however, cutting but a small figure in the matter, the average condensation being 7 galls. an hour per car. To heat each car, allowing the average condensation of water to be 6 lbs. of water to 1 of coal consumed, we find the cost to be ¾ of a cent per hour for steam furnished from the engine, against 3 to 4 cts. per hour where cars are heated by stoves.

I understand that it has been the opinion of some, that steam heating for cars was impracticable, on account of the extra draft of steam from the engine to supply a continuous train of 9 to 12 cars. But I must say that I fail to find any material difference in the steaming of our engines owing to this increased demand; and that the heating of cars by steam, as far as we have gone, I consider an entire success.

Very truly yours,

JAMES MACBETH.

MR. MARDEN. (Fitchburg).—It is unfortunate that a steam coupling should not have been presented that would be acceptable as a uniform coupler for all the roads. I think it is very important that whatever coupler is used should be uniform on the different roads, almost as necessary as it is to have a uniform brake coupler, but I don't think the roads would have been justified in adopting any one of the couplers which so far have been presented. There is no doubt that it would be desirable to have a coupler as nearly on a line as possible, that is, not to have sags in it; and it is also desirable to have a tight coupler, which can be quickly coupled and which will uncouple automatically when the cars are detached from each other. There is one point in steam heating of trains that I think this writer's experience will demonstrate, and that is, as MR. ADAMS has said, you will find that our cars are too hot; that has been my experience on all the roads on which I have traveled. There is, perhaps, none too much pipe in the cars to make them comfortably warm on extremely cold days, but when they are heated up it takes a good while to cool them off; and when the steam is shut off completely, unless special care is taken, the cars will become too cold. The thought has occurred to me that perhaps we could have divided lines of pipes in the cars; one line of pipe on the sides could be used in moderate weather, and as the colder weather came on, put one or more of the other lines in use.

We have been using the Sewall system of heating, and we have also used the couplings attached to that system with good results. They are tight, and we have no trouble from leakage of steam. On the Fitchburg road we have appointed a man who has charge of the steam heating and air brakes on the line of the road, and it is his business to go over the line and instruct the train men as to their duties, both as to air braking and steam heat. (In reply to a question.) So far as our experience has gone, the sag in the coupling does not seem to give us any trouble. We have had only one instance in which a coupler has frozen up, and that was the fault of the trainmen. We have had no trouble from condensation and no difficulty in heating six or seven cars in the coldest weather we have had this winter.

MR. SHINN. (N. Y. & N. E.).—The most important point about steam coupling, I think, is to decide whether a straight-line coupler is absolutely necessary, one without a sag. Railroad men ought to be informed as to whether they can accept a coupler that is flexible and swings. At a meeting at Albany, some months ago, it was asserted that the sag in a flexible coupler was objectionable. I found afterwards that the coupler advocated by the gentleman who made this statement had more sag than the one objected to, although he considered a straight-line coupler as a necessity; and the pocket in his coupler, made to hold water, was larger than in any I had heard of previously.

MR. MARTIN.—There is no doubt that it would be a benefit for the roads to have a uniform coupler, but in the present state of development, it is a matter of impossibility, owing to the fact that the men at the head of the mechanical departments of the different roads have very decided views upon this matter, and as long as there is that difference of opinion, there will constantly be different things tried. If the railroad men will, after the experience of the past, and of this winter and the next, give up their own particular opinions in this matter and conform to the judgment of the greatest number as to what will be the best coupler to use, they will hasten the day when there will be uniformity. In the Martin coupler we have done away with the extension joints; they are so constructed that in case the cars come apart, they will uncouple without damage to the couplings, and the heavier the pressure on the main pipe, the tighter the flexible portion is; it is absolutely tight and works successfully; we have seen no vapor coming from it in 6 weeks. Should it run 6 months in that way and need attention, 40 cts. will place it back as good as when it started in the fall. We believe in having as little sag as possible. We believe if we could get a coupler, simple in construction and capable of being easily repaired, and that could be uncoupled without injury, and not liable to leak under pressure, some of the chief requirements would be met. Concerning the system of piping, MR. MARDEN suggested the propriety of separating the sections of pipes, but you will not get uniformity of heat in that way. There is a device in existence which will regulate the heat within 2°, the objection to which is the large price that is asked for it.

MR. ADAMS.—As to keeping the cars at a uniform temperature, and pleasing all the passengers, that is an utter impossibility, there is so much difference of opinion and feeling on the subject. I find that a thermometer placed where it can be seen in the car does not indicate the heat there may be down on the seats of the car, nor nearly so. We made some experiments recently which showed that there is a large difference between the temperature at the seats and that in a place as high as the head. The desirable thing now is to perfect our couplers so that they will carry steam without leakage, and yet have sufficient longitudinal motion to meet the movements of the train. This new coupler of MR. MARTIN'S seems to meet these requirements.

MR. MCELROY.—In our coupler there is a straight opening and straight passage for the steam. It disconnects automatically, and has proved perfectly tight. We use hose between the cars, requiring no particular care. It has the disadvantage of comparatively short life. We are running hose, however, that we had in use last winter, although we have had hose give out in two months' time. The hose we are using now gives promise of longer life than that we first used. The difficulty of preserving a uniform temperature in the cars with steam heat can be overcome by having a regulating valve in each car, for the purpose of reducing the pressure in the car when necessary, and making hand regulation possible. We are introducing this arrangement at the present time.

PROF. LANZA (Mass. Inst. of Tech.)—In my report to the Railroad Commissioners I recommended the Westinghouse air brake coupling with a hard rubber gasket; and although the fact that nobody has any money invested in it will be likely to militate against its adoption, nevertheless, I think I ought to say a few words about the matter. I presume it is conceded by all that uniformity in steam coupling is desirable. Whether it is a necessary prerequisite to the general use of steam heating or not is a disputed question. It is clear to my mind that if uniformity is to be attained, somebody must adopt a coupling which, though a good one, is not the one which he considers to be the best in the market, as it is impossible to make all men think just alike. If the points above are well taken, the next thing to be done is to eliminate from consideration those couplings which by reason of serious defects show themselves to be entirely unsuitable, and then to make a choice from among the others. My experience with steam couplers was had last winter, and I speak on that basis. I should discard at once all couplers which depend for flexibility on slip joints and ball joints, as they are sure to leak. This is so evident to mechanical men that I do not think I need cite any of the evidence in support of it.

We come then to a choice of some one of those which depend for their flexibility on a flexible rubber hose, and of those there are a great many, and quite a number of good ones. I should also limit myself to those which uncouple automatically when the cars break apart, as otherwise there is always more or less trouble from breakage of hose. It has been claimed that the pocket formed by this kind of coupling is liable to become full of water, and either freeze or at least cause an undue resistance to the passage of steam. In regard to this I will say that the facts prove that none of these claims are true. They do not collect water, and the resistance to the passage of

steam is so slight as to be practically inappreciable.

We are brought, then, to a choice of some one of this class of couplings, *i. e.*, those which depend for flexibility on a flexible rubber hose, and which uncouple automatically when the cars break apart; and I believe that if uniformity is ever attained, it will be by a choice of one of this class of couplings.

Of this class there are a good many that are good enough for all practical purposes; but when it comes to deciding which is the best of them, I do not believe it will ever be possible to get railroad men to agree. Hence, if any one of them is adopted by all, it will not be considered the best by all railroad men; and therefore there has got to be a compromise of some kind.

My principal reasons for recommending the Westinghouse 1 1-2-in. air brake coupling with a hard rubber gasket are, as stated in the report, first, that the train hands are all familiar with it; and next, the patent having expired, it is much the cheapest. To this I will add that I have watched its operation on the New York & New England R. R., and also on the Boston & Albany, and I have failed to see any objectionable feature about it; and, as far as I could see, it worked in a thoroughly satisfactory manner; indeed, I have not seen any coupling that worked any better. I have read and heard objections made to it, but all of them have been purely theoretical, and are not borne out in practice. I have not yet seen a railroad man who has used it able to cite any trouble that he has had with it. This coupler can be bought for about one-sixth the price of any other coupler in the market. The Sewall coupler is practically the same thing, just as simple and effective. The only fault to be found with it is that it is patented.

Mr. MARTIN.—I don't know why the Westinghouse Co. have abandoned the Westinghouse coupler, unless they found something better that led them to do so. They even go so far as to use a slip joint with a short rubber gasket.

Prof. LANZA.—The reason why they do not use it is because they would make no money out of it.

Mr. SHINN.—Prof. LANZA has referred to the fact that the New York & New England R. R. is using the Westinghouse coupler. We adopted it because it was cheap and convenient; we had it in stock and it was sufficiently effectual for temporary use, and while using it we could see if anything better appeared; we have not committed ourselves to anything. I never knew of any considerable amount of steam heating that had not some leakage. That has been partially overcome in this instance, and I think it will continue to answer the purpose until we are called upon by the Commissioners to adopt something permanent, or until the roads in general agree upon what is best.

Mr. CHASE.—It is not necessary to have it absolutely tight.

A discussion then followed between President LAUDER and Mr. CHASE, in which the latter claimed that the Westinghouse coupler was unsuited to steam heating, on account of leakage through wear of the hard rubber gasket.

Mr. SEWALL.—When we commenced experimenting with steam heating, we attempted to use the Westinghouse coupler, but found that the gasket would not remain tight, although it might in the use of the air brake coupler. In the use of steam, the expansion will cause the gasket to press so tightly that the feature of automatically uncoupling will be liable to be destroyed, and there is a possibility of a rupture of the whole, if the coupling is so tightly adjusted as to prevent any leakage. We made an effort to use that coupler without success, and found we must devise one without these fatal defects. The result is the one we are now using, which is simple and successful. One of its features is an air space round the tubes, which acts as a non-condensing surface, so that we get the least amount of condensation.

The Club voted to hold a dinner on Wednesday, March 13, the date for the annual election of officers, and to extend invitations to the Members of the Northwestern R. R. Club of St. Paul, the Western R. R. Club of Chicago, the Central Ry. Club of Buffalo, and the New York Ry. Club.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Delaware & Hudson Canal Co. About 14 miles of double tracking was completed during 1888, on the Northern division of this system; 8.94 miles betwen Schenevus and Cooperstown Jc., and 5 miles between Unadilla and Sidney.

McKeesport & Belle Vernon.—This Pennsylvania road was opened for passenger traffic this week between McKeesport and Elizabeth.

Toledo, Saginaw & Mackinaw.—It is stated that this road, built last season from Durand, Mich., to East Saginaw, about 40 miles, will probably be sold either to the Grand Trunk or the Toledo, Ann Arbor & North Michigan. The line is now operated as part of the latter company's system.

Grand Trunk.—The City Councils of Hamilton, Ont., have decided to oppose the proposed spur line projected by this company to join the Hamilton & Northwestern division with the Great Western railway at Stony Creek. A deputation will go to Ottawa to fight the application before the Privy Council.

Canadian Pacific.—The rumor that the company intends to build a bridge across the Niagara river at Lewiston, is still circulated, and may have some foundation. It is generally believed that the Niagara Central railroad, which is now completed from the Niagara river, west, 12 miles, and is projected to Toronto, is backed or is to be backed by the Canadian Pacific; and if the system reaches the Niagara river, it is quite certain to have close connections there with the systems on the American side.

Maryland Central.—According to Mr. GEO. JEWETT, President of the Deer Creek & Susquehanna Railroad, now under construction, the present owners of the Maryland Central have some ambitious plans under consideration. One of these is an extension to secure direct connection with the Lehigh Valley system. From the Deer Creek & Susquehanna terminus near Conewingo, Md., a line would be built to a point on the Wilmington & Northern near Coatesville, Pa. The track of this road would be used to a point on the Delaware river a few miles below Reading, Pa., and a road would be constructed from here to Bethlehem, Pa., on the Lehigh Valley. This move, according to Mr. JEWETT, would practically be an extension of the Reading and Lehigh Valley systems to Baltimore, which he thinks would be of great advantage to that city.

Central Railroad of New Jersey.—Surveys are reported in progress for an extension from Wilkesbarre, Pa., west to Millville, the eastern terminus of the Wilkesbarre & Western. This road is 21 miles in length and was built 3 years ago, and originally projected to run to Wilkesbarre.

Wheeling & Lake Erie.—It is stated that this company has quietly made surveys and is now planning to begin work soon on an extension to Pittsburg, Pa. The line will run via the Castle Shannon Valley, but from what point on the company's present line or its extension to Wheeling is not known. It is quite possible that the only foundation for the rumor may be the surveys made last summer for the proposed independent road from Wheeling to Pittsburg, and that the Wheeling & Lake Erie company has no intention of building to Pittsburg.

Cleveland, Lorain & Wheeling.—About a mile of track has just been laid at Martin's Ferry, O., for the purpose, it is said, of obstructing the building of the Wheeling & Lake Erie and the Cleveland & Wheeling extensions now under construction. It is also stated that the new line will be continued to Steubenville.

New York & Massachusetts.—Tracklaying is to begin at once on the connecting tracks between this road and the eastern terminus of the Poughkeepsie bridge.

American Midland.—According to a recent press dispatch from Ft. Wayne, Ind., this company, which is building the Indiana division of the New York, Mahoning & Western, is pushing work on the grading and will begin tracklaying very soon, with the intention of completing its line from Ottawa to Ft. Wayne by May 15. Contracts have been let for the erection of repair shops, and a round-house at Ft. Wayne to cost $200,000. It is stated that a car manufactory will be located at Ft. Wayne in connection with the shops, to be run by a private company which has made a permanent contract with the railway company for their car building and repairing.

Cleveland & Western.—It is announced that grading will begin as soon as spring opens on the proposed extension from Akron to Carey, O. The project has been a long time under consideration and there is little doubt that it is intended to build it as soon as capital can be secured. WM. SEMPLE, of Allegheny, Pa., is President.

Columbus, Lima & Milwaukee.—President B. C. FAUROT, of Lima, O., was recently interviewed by a Detroit *Free Press* reporter and gave the following information in regard to his enterprise:

The right of way has all been secured between Lima and Defiance, with the exception of a few tracts which are owned by heirs; and cars will be running between these two cities by Nov. 1 of the current year. The contract has been let to S. G. Clarke, of Chicago, who will commence work just as soon as the right of way has all been settled. The road will be equipped with No. 1 rolling stock and with 70-lb. steel rails.

The southern terminus will be at Marietta, when the road is finished; but at present it will not be built further than Boutwell, 30 miles from Marietta. Saugatuck is the objective point in the north. This place is 80 miles from Milwaukee, 90 miles from Chicago, and 70 miles from Racine. We shall run steel transports from Saugatuck to Milwaukee. The entire line is 425 miles long. We will construct a belt road at Columbus as soon as possible.

My original intention was to secure a direct line from Northwestern Ohio to Columbus. I found this impracticable, however, and then I came to the conclusion that if I could build a line from the Ohio river to Lake Michigan it would be a paying investment. We intend to exchange the coal, potters' clay, stone, and oak timber, of Ohio, for the ore and pine of Michigan. I have spent the last 3 years in working up this line, and when it is completed I have no doubt but that it will take a front rank.

Michigan towns are interesting themselves in the proposed road, and are endeavoring to have South Haven instead of Saugatuck adopted for the Lake Michigan terminus.

Pennsylvania.—About $4,000,000 of new stock is to be issued by the company this spring, the proceeds to be used to pay for the new elevated tracks at Jersey City, the enlargement of the Broad Street Station, Philadelphia, further improvements of the roadbed, and additional tracks on the main line.

Evansville & Terre Haute.—It is currently reported that this company, whose lines are commonly known as the Mackey system, is soon to absorb several roads in its vicinity, among them the Louisville, Evansville & St. Louis and the Ohio Valley. Besides these lines, Mr. MACKEY is now building an extension from Elnora & Richmond, Ind., and is said to be planning to secure the Illinois & St. Louis and build a line between Belleville and Mt. Vernon, Ill.

New York, Ontario & Western.—President FOWLER has issued a circular to the stockholders asking their assent to a project which the directors have approved for the refunding of the whole bonded indebtedness of the company at a low rate of interest and providing funds for building the extension to Scranton, Pa. This extension is to be built by the Scranton & Forest City and the Hancock & Wyoming companies, and will join the main line at Hancock, N. Y. The line will cross the Erie road above grade at this point, cross the Delaware river by an iron bridge, and run via Forest City, Carbondale, Archibald, and Providence to Scranton, where connection will be made with the Delaware, Lackawanna & Western and the Central Railroad of New Jersey systems. It is believed that the new branch will be a very valuable feeder to the main line.

Detroit & Bay City.—The Lapeer & Northern branch of this Michigan road, a part of the Michigan Central system, is to be abandoned this spring. The line runs from Lapeer to Five Lakes, 8.75 miles.

Lakeside & Marblehead.—An extension under the name of the Tiffin & Fremont Railroad is proposed from Danbury to Upper, Sandusky, O. Chief Engineer J. G. KANEY, of Toledo, O., will make surveys in a few weeks.

Cincinnati, Hamilton & Dayton.—The Grand Jury of the City of New York has brought an indictment for grand larceny against HENRY S. IVES, *alias* The Napoleon of Finance, and GEO. H. STAYNER, who for some time have been unwilling residents of Ludlow Street Jail in this city. The charge against them is the misappropriation of trusts funds during the palmy days when they were at the head of the Cincinnati, Hamilton & Dayton Railroad, and figuring prominently in deals with all the railway magnates in Wall Street.

Projects and Surveys.

Kinderhook, Valatie & Stuyvesant.—A correspondent sends us the following information:

During the last few years local parties have organized the Columbia & Hudson R. R. Co., the Kinderhook & Hudson R. R. Co. and the Kinderhook, Valatie & Stuyvesant R. R. Co. for the purpose of building a line of railway from Kinderhook Station on the Boston & Albany R. R. via Columbiaville, Valatie, Stockport and Stottsville to Hudson, about 16 miles; but being inexperienced in the railway business, and not knowing how to proceed, they have finally abandoned the projects. There is no question but that the traffic of a road over this route would be very large. Valatie alone has 6 large cotton and knitting mills, and the whole valley to the Hudson is filled with manufacturing villages.

Vincennes, Oakland City & Owensboro.—J. C. RUDD, of Owensboro, Ky., President, has sent us the following:

Fifty miles of the right of way for this road has been obtained, leaving 20 miles more to be negotiated for, and $86,000 local aid has been donated.

This company was chartered in 1887 to build a line of railway from Vincennes, Ind., to Owensboro, Ky., a distance of 70 miles. W. B. EALLS, of Owensboro, is Chief Engineer.

Montpelier & Chicago.—We have received the following information from GEORGE STRAYER, of Montpelier, O., Secretary of this company:

This road was chartered Jan. 11, 1889, to run from Montpelier, Ohio, to Chicago, over the abandoned roadbed of the old Chicago & Canada Southern. Surveys will commence about May 1, 1889. The road is projected to furnish a short line to Chicago for the Wabash. About 24 miles right of way has been secured. The president of the company is D. STAUFFER, of Montpelier.

Sanford & Kennebunk.—At a meeting of the citizens of Sanford, Me., recently held, a committee consisting of E. K. BENNETT, B. F. HANSON, W. H. NASON, O. V. LIBBY, D. G. CLARK, HOSEA WILLARD, and M. W. EMERY, was appointed to solicit subscriptions to the stock of this company.

Phillips & Rangeley.—A bill is before the Maine Legislature, incorporating a company to build a line of railway from Phillips to Rangeley, about 11 miles.

Terminal City.—A company to be called the Terminal City Co. has been chartered by the Parliament of Nova Scotia, with the following officers: CHARLES H. LEWIS, President; H. M. PEARL, Secretary; and FREDERICK R. PAGE, Chief Engineer. The projectors of the company have purchased lands near the proposed future terminus of the Canadian railways on the eastern coast of Nova Scotia, which is 800 miles nearer Liverpool than is New York City, and propose to further the building of extensive terminals and wharves at this point for the accommodation of the great traffic which they expect will center there. The headquarters of the company are at 31 Milk St., Boston.

Troy & Lansingburg Rapid Transit.—A project is

on foot to build a steam railway from a point in Waterford to Troy. The route as proposed will pass along South Ave., Lansingburg, cross the Hudson river at Waterford, and connecting with the Fitchburg R. R. at Cemetery Ave., will enter the union station at Troy. The estimated cost of the road, including a bridge across the Hudson and 5 stations, is about $250,000.

Barnegat Park.—The surveys for this road are nearly finished, and it is reported that construction has begun on a portion of the line. Contracts for the construction of the remainder will be let soon. The officers of the company are JOHN B. LARNER, of Washington, D. C., President; EDWARD S. FARROW, of Barnegat Park, N. J., Vice-President; and WILLIAM L. BRUEN, of Barnegat Park, Secretary and Treasurer.

SOUTHERN—Existing Roads.

Florence Northern.—Mr. A. G. NEGLEY, Jr., of Florence, Ala., sends us a map of this projected line and the following information:

Preliminary and locating surveys have been completed on this road from Florence, Ala., north to Buffalo river, 52 miles. The route chosen is through Lauderdale county, Ala., and Wayne, Perry, Humphrey and Stewart counties in Tennessee. The line is projected to extend about 150 miles north to meet the Ohio Valley road at some point on or near the Cumberland river. Right of way is mostly procured and a contract has been let to the Alabama Construction Co., 25 miles to be completed within 4 months, and the balance within 1 year. W. H. WOOD, of Florence, is President, and A. G. NEGLEY is Chief Engineer.

Charleston, Cincinnati & Chicago.—As noted on our Engineering News page, the work on this road is now to be pushed by Messrs. McDonald, Shea & Co., the contractors.

Richmond & West Point Terminal.—The petition to the Attorney General of Virginia, that proceedings be instituted for the forfeiture of this company's charter, has been denied on the technical ground that the suit should have been brought in King William county where the company's principal offices are located.

Plans have been perfected for refunding the bonded indebtedness of this company. A mortgage for $25,000,000 will be issued as needed to take up bonds and preferred stock of various issues, and to provide for further extensions, or the acquirement of other roads.

Cincinnati, New Orleans & Texas Pacific.—The seventh annual report of this company shows as follows:

	1888	1887
Gross earnings	$3,624,490	$3,377,552
Operating expenses	2,419,536	2,034,572
Net earnings	1,204,954	1,342,980
Fixed charges	992,659	994,213
Surplus revenue	212,295	348,765

The cost of the accident to the limited express on Dec. 31, 1888, amounted to $79,341, which was charged to the operating expenses of 1888.

Pensacola & Memphis.—A company has been organized to build terminals for this company at Pensacola, and has purchased the Barcelona St. wharf.

Lynchburg & Durham.—Contracts have just been closed for the extension to Durham, N. C. The company will secure an amendment to its charter allowing the line to be continued from Durham south to Fayetteville, N. C., about 65 miles. J. W. GOODWIN, of Lynchburg, Va., is Chief Engineer.

Durham & Henderson.—Tracklaying is completed on this branch of the Seaboard Air Line system extending from Durham to Henderson, N. C., 44 miles. It is thought through trains will begin running by March 1.

Alabama Midland.—About 1,000 men are now grading between Bainbridge and Troy, Ala., and the engineers are now locating the line between Troy and Ada, which division will be let to sub-contractors as soon as possible. The iron bridges for the Flint and Chattahoochee rivers have been finished at the shops and are expected to be erected and ready for trains by May 1. The New Orleans *Times Democrat* says: "They will be open drawbridges of iron, steel and masonry, and up to Cooper's standard in every particular." A large part of the road's equipment has been delivered at Bainbridge, Ga., and tracklaying is to begin as soon as the temporary bridge across the Flint river can be used. R. M. WALKER, is in charge of the bridge work, J. M. WOOLFOLK, President of the Construction Co., and Jas. M. Brown & Co, the chief contractors, have headquarters at Bainbridge and are pushing the work.

Atlantic & Danville.—About 8 miles of grading have been completed from Danville, Va., east, and 600 hands are at work between Danville and Milton, N. C.

Mobile & Ohio.—It is again reported that the proposed extension from Corinth, Miss., to Birmingham, Ala., is to be built. The line was chartered two years ago as the Birmingham & Northwestern Railroad, but it was generally understood to be a project in the Mobile & Ohio interest. The proposed line would be about 150 miles in length.

Atlantic Coast Line.—Track-laying on the Scotland Neck extension in North Carolina is completed to the junction with the Albemarle & Raleigh R. R., 24 miles from Scotland Neck. Grading is nearly finished from this point to Greenville, 14 miles, and the line is being located on south to Kingston and Jacksonville, Onslow county, about 65 miles.—On the extension from Williamston to Plymouth, 22 miles, 6 miles have been graded and the remainder is under contract.

Richmond, Nicholasville, Irvine & Beattyville.—The contract for 25 miles of this road from Nicholasville to Richmond, Ky., has been let to D. SHANAHAN & Co. Grading is to begin at once, and the work is to be completed by Sept. 1, 1889. The whole line is under contract to the Ohio Valley Improvement & Contract Co., of which J. H. PEARSON, Nicholasville, Ky., is Chief Engineer.

Apopka City & Clay Springs.—The contract for grading this Florida road has been let to R. C. WATERS, of Apopka.

Union Point & White Plains.—This Georgia road was partially graded some time ago, but the company was unable to secure funds to complete the road and the enterprise was abandoned. Recently a new company has been organized with JOHN HART, of Union Point, as President. Local aid to the amount of $10,000 and the right of way has been secured and the contract has been let to the Georgia Railroad Co., to complete, equip, and operate the road. Grading has already begun, and it is expected to have the whole line of 13 miles in operation within three months.

Chowan & Southern.—The name of this road has been changed to the "Norfolk & Carolina Railroad." The line is under construction from Norfolk, Va., southwest to a junction with the Richmond & West Point Terminal and Atlantic Coast Line systems, and will be used jointly by these companies. GEO. S. SCOTT, of the Richmond & Danville, is President, and G. M. SERPELL, 100 Main St., Norfolk, Va., is General Manager.

Projects and Surveys.

Covington, Alamo & Dresden.—Incorporated in Tennessee to build a line of railway from Covington via Alamo to Dresden, about 60 miles. Among the incorporators are W. C. BOYCE, J. C. BOALS, WM. SANFORD, and R. H. GREEN.

Chattanooga, Missionary Ridge & Chickamauga.—Organized in Tennessee to build a line of railway from Chattanooga to the top of and along Missionary Ridge to the Chickamauga battle-field, a distance of about 12 miles. It will be built to carry visitors to the battle-field and is expected to be completed by the fall of 1889.

Union Springs & Chattanooga.—Incorporated in Alabama to build a railway from Union Springs to Anniston, a distance of about 140 miles. Among the incorporators are the following: S. T. FOSTER, B. T. ELY, M. R. SUMMONS, and J. A. PAULK.

Meagher Pole Road.—We have received the following from JOHN MEAGHER, of Frankfort, Ky.:

I desire to build about 10 miles of pole road, and to equip it with an engine and cars, for the purpose of getting out logs and railroad ties from my timber lands. Where can I get information of the probable cost per mile, and the makers of said machinery?

Chattanooga, Cleveland & Murphy.—It is reported that a company has been organized in Tennessee, with E. WATKINS as President, to build a railway from Chattanooga, Tenn., to Murphy, N. C., about 60 miles.

Staunton & West Augusta.—A company has been organized in Virginia to build a railway from Staunton to the anthracite coal fields in the northeastern part of Augusta county, about 20 miles. JOHN D. CROWLE, of Staunton, is President, and W. P. TAMS, of Augusta, is Treasurer.

Monticello & Griffin.—Col. E. C. MACHEN, who has just completed the Covington & Macon Railroad, is now securing right of way for a line from Monticello, on the Covington & Macon, to Griffin, on the Georgia, Midland & Gulf, and the Central of Georgia systems.

Chattanooga & Augusta.—Incorporated in Tennessee to build a railway from Chattanooga east along the Ocoee river to the Tennessee boundary line, about 45 miles. Among the incorporators are E. M. KILPATRICK, R. C. BOWIE, JAMES PARKS, and I. L. HAMPER.

Decatur & South Mountain.—It is stated that a New York syndicate is willing to construct this road and equip it for both freight and passenger traffic. The road will be about 10 miles long, and will cost about $100,000. Work will be begun as soon as the City Council of Decatur, Ala., grants the right of way over Market St., and it is expected that the road will be completed within a year.

THE NORTHWEST—Existing Roads.

Chicago, Burlington & Quincy.—The company has issued the following statement of the results of its operations for 1888:

	1887	1888
Gross earnings	$27,576,078	$23,789,167
Operating expenses	15,212,875	17,804,112
Net earnings	12,363,202	5,985,054

The increase in operating expenses is due to the strike and to the heavy traffic of the year, which would have given the company a proportionate increase of earnings if rates had not been cut during a large part of the year. The statement for the month of December, 1888, showed gross earnings of $2,167,673, an increase of $4,285 over December, 1887. But operating expenses increased $318,048. At a meeting of the directors on Feb. 14, a dividend of 1 per cent. was declared for the quarter year. The company is exceptionally fortunate in having a surplus on which it can draw for the payment of dividends until it can increase its net earnings to a dividend basis.

Sault Ste. Marie & Southwestern.—This company will soon issue a prospectus of the enterprise which it has projected, and will endeavor to secure foreign capital for the construction of its road. N. C. FOSTER, of Fairchild, Wis., is President.

Cairo, Vincennes & Chicago.—This company has been reorganized and is to be taken out of the Receiver's hands at an early date. At a meeting at Danville, Ill., on Feb. 16, LLEWELLYN THOMAS was elected President and M. A. MCDONALD, General Manager. One of our contemporaries publishes a report that the company is planning to begin work in the spring on a line from Cairo south to Memphis, Tenn. It does not seem likely, however, that the company could obtain just now the capital required to build such an extension.

Chicago & Alton.—The report of this company's operation for 1888 gives the following figures:

	1887	1888
Gross earnings	$8,941,386	$7,511,465
Operating expenses	6,270,202	4,668,084
Net earnings	3,671,184	2,843,381

Chicago & Western Indiana.—This company will issue $1,000,000 in bonds to raise funds for permanent improvements to the road, buildings, etc.

Milwaukee & Northern.—A force is at work clearing the right of way for the extension of the Ontonagon & Brule River road, and it is intended to have it ready for grading as early as the weather will permit.

Canadian Pacific.—It is stated that the extension from Carman to Manitou, Manitoba, will be undertaken this summer.

Northern Pacific & Manitoba.—The final agreement between the Provincial Government of Manitoba and the officers of this company has been published. Under it the maximum rate from Winnipeg to Duluth is to be the same as the Canadian Pacific rate from Winnipeg to Port Arthur. Reports are conflicting as to the nature of other parts of the agreement. The opponents of the Government are making the matter a political issue and declare that Premier GREENWAY has made a sorry bargain for the Province.

Projects and Surveys.

Chicago, Freeport & Sioux City.—ABRAM L. BRINK, of Warren, Ill., sends us the following:

Our company is not yet fully organized. The proposed road is to run from Freeport, Ill. to Sioux City, Ia., and surveys will be begun about April 1, 1889. There will be a large bridge across the Mississippi river. The road will receive the traffic from one of the richest sections of the country and will secure a heavy trade from the far West.

St. Paul, Black Hills & Pacific.—It is reported that the surveys for this line have been finished and that work on construction is to begin about May 1. Contracts for construction will be let by the chief engineer about March 20. The road is projected to run from Dickinson to Deadwood, Dak., with a branch from Aberdeen to Milner, in all a distance of 278 miles. W. L. RICHARDS, of Aberdeen, is Chief Engineer.

Mississippi & Leech Lake.—A survey is soon to be made for this road, which is to run from Little Falls, Minn., southwest through Swan River and Elmdale to the Minneapolis & Pacific or the St. Paul, Minneapolis & Manitoba Railroads. A. M. MORRILL, of Little Falls, is President of the Company.

Brandon, Souris City & Rock Lake.—At a recent meeting of the citizens of Pilot Mound, Man., it was resolved to ask aid from the Government in building this proposed road. The road is projected to run from Brandon via Souris City to the international boundary, about 60 miles.

Danville, Chicago & Northwestern.—M. A. MCDONALD, of Danville, Ill., General Manager of the Cairo, Vincennes & Chicago Ry., sends us the following:

The surveys for this road, which is to run from Tilton, Ill., via Paxton and Melville, to Strawn, Ill., about 65 miles, were begun Feb. 1. Work is light except near Tilton. The road will form a connecting link between the Cairo, Vincennes & Chicago, and the Wabash R. R., and will receive the local coal and grain traffic. Gen. JOHN MCNULTA, Receiver of the Wabash, is President, and CHARLES HANSELL is Chief Engineer. The company was incorporated Jan 1, 1889.

Alaska.—In a lecture recently delivered at Winnipeg, Man., U. S. CONSUL TAYLOR advocated the building of an International Railway from the United States to Alaska. The road would start from some point on the international boundary and run via Ravelstoke, Man., to the boat landing at the bend of the Columbia river, thence along the valleys of the Canoe and Frazer rivers northwest via Fort George to Norton Sound, on the coast.

Calgary, Alberta & Montana.—A bill is before the Canadian Parliament granting A. E. SHELTON and J. D. LAFFERTY, of Calgary, Alberta, and D. W. DAVIS and E. D. WOOD, of Fort Macleod, a charter to build a line of railway from Calgary south, via the forks of Mosquito Creek and Fort Macleod, to a point on the international boundary.

THE SOUTHWEST—Existing Roads.

Denison, Bonham, & New Orleans.—W. T. NEVINS has been appointed Receiver of this Texas company on

application of the First National Bank of Denison, Tex.

International & Great Northern.—This Texas system, formerly part of the Missouri Pacific, was placed in the hands of Receivers on Feb. 20. The road extends from Laredo, Tex., to Longview, with a branch from Palestine to Galveston, a total of 825 miles.

St. Louis & San Francisco.—The first train over the extension from Malden to Delta, Mo., was run on Feb. 17. The line is 50 miles in length.

Atchison, Topeka & Santa Fé.—The long expected report of the company, giving the results of operations for the 11 months ending Nov. 30, 1888, has been issued; but the relations of the parent company to its controlled lines are so complicated that Wall Street has contented itself with looking wise over the report and wondering what it meant. The total capital stock and debt of the company is given as $136,976,302. The mileage of the whole system is now 7,121 miles, and 3,506 miles are included in the Atchison system proper. On this latter mileage the following report is made for the 11 months ending Nov. 30:

Gross earnings	$8,272,642
Operating expenses	7,232,863
Net earnings	909,778
Fixed charges	3,969,227
Deficit	2,969,449

Kansas City, Ft. Smith & Southern.—Efforts are being made to raise funds in Kansas City in aid of the extension south to Bentonville, Ark.

Houston, Central Arkansas & Northern.—Work is to be pushed on this Louisiana road at once. Besides the force of convicts from the Louisiana Penitentiary, several sub-contractors have taken work, and it is hoped to finish the line between Bastrop and Columbia, La., by June 1. C. G. WOODBRIDGE, of Monroe, La., is Chief Engineer.

Kansas & Arkansas Valley.—The right of way is secured and grading has begun on the extension from Wagoner, Ind. Ter., to Coffeyville, Kan., about 90 miles. The road was built last year from Van Buren, Ark., to Wagoner, 83 miles.

Kansas City, Wyandotte & Northwestern.—The report of this company for the year ending Jan. 1, 1889, has been issued. The company owns 136.5 miles of main line extending from Kansas City to Seneca, Kan. On Nov. 1 an extension was authorized by the board of directors from Seneca to the Nebraska State line, 23.2 miles. After the road had been partly graded, a contract was made for a trackage right over the St. Joseph & Grand Island road from Seneca to Axtell; and from Axtell to the State line the road is now about completed. The earnings for the last half of the year were $181,521, and the operating expenses were $108,862, leaving net earnings of $72,659.—— Surveys are reported in progress for the extension to Beatrice, Neb.

San Antonio & Aransas Pass.—The company has offered to build the extension to Brownsville, Tex., 150 miles in length, if a subsidy of $150,000 is raised. Nearly two-thirds of this sum has been secured.

Projects and Surveys.

Kansas City Circle.—At a recent meeting of the Kansas City Circle Railway Co., the following officers were elected: E. F. ROGERS, President; L. G. A. COPLEY, Secretary and Treasurer; and WM. B. KNIGHT, General Manager and Chief Engineer, all of Kansas City, Mo. The object of the company is to construct a double track railway around Kansas City. The length of the line to be constructed is about 25 miles. Work is to begin at once.

New Birmingham & Paris.—It is reported that construction has begun on this road, which runs from New Birmingham to Paris, Tex.

ROCKY MT. AND PAC.—Existing Roads.

Union Pacific.—The Carbon Cut-Off Railway Co. has been chartered in Wyoming, in the Union Pacific interest, to build a road from Sulphur to coal fields, 15 miles northwest, with branches to any coal or mineral deposit in Carbon, Sweetwater, or Fremont counties. It is stated that the company also intends to build north, to tap the Wyoming oil fields, and thence to Billings, on the Northern Pacific. It is conjectured that the Billings, Clark's Fork & Cooke City road, now under construction, is backed by the company. The surveyors in Northern California are still at work making surveys through various passes and by different routes. From all appearances the company is planning a very extensive construction campaign, although President ADAMS has frequently expressed himself as opposed to a wholesale extension policy. He is recently quoted as saying:

> We have some money in the bank, and we propose to keep it there. We have not a note outstanding; we are not building a foot of road nor incurring any liabilities. There is no basis for these dividend reports, so far as the Directors of the Union Pacific are concerned. There is no change in the policy of the Union Pacific Company, so far as I know, and none is contemplated.

Chicago, Burlington & Quincy.—The most important extensions which this company has under way are the lines from Alliance, Neb., northwest into Wyoming. It is intended to tap the oil and coal fields of the territory. It is also stated that the company is widening the gauge of the Denver, Utah & Pacific to standard and is to extend it north via Ft. Collins and Laramie to the Carbon county coal fields.

San Francisco & Northern Pacific.—The last spike was driven on the Sonoma & Ukiah extension on Feb. 9, by President J. M. DONAHUE.—About $150,000 has been subscribed to aid the extension from Petaluma to Sebastopol and it is believed the line will be built.

Southern Pacific.—Subscriptions to the amount of $4,640 have been made to procure right of way for the proposed extension from Oakdale to Merced, and a corps of surveyors are now locating the line.——On the coast line extension a party is making surveys south of San Luis Obispo. Right of way is not yet secured at that city and work is not likely to be pushed until that matter is settled.——It is believed that the extension to Seattle, W. T., will be undertaken this year.

Kansas City, El Paso & Mexican.—At the annual meeting, held at El Paso, Tex., Feb. 12, B. H. DAVIS was elected President; W. C. MASTEN, General Manager, and H. V. ESTILL, Chief Engineer. A telegram from the New York syndicate which is building the road was read, stating that all the indebtedness would be met when the bonds were issued and the El Paso subsidy of $50,000 was paid. By the secretary's report, the company has built 10 miles of road at a cost of $105,554, and has expended $42,459 in grading 20 miles additional and in making surveys over 150 miles of the proposed route.

Oregon Ry. & Navigation Co.—Several sub-contracts have been let for the extension across the Coeur d' Alene Indian reservation, and it is intended to push work as soon as spring opens.

Northern Pacific.—Tracklayers on the Big Bend branch have reached Mondovi, W. T.——It is reported that the company is to make surveys for a new route through the Pipestone pass, with a view of abandoning the Mullan tunnel.

Oregon & Washington Territory.—The proposed extensions to Pendleton, Dayton, and Waitsburg seem likely to be built. President G. W. HUNT has agreed to build, if the required subsidies are raised.

Silverton.—A branch of this Colorado road will be built to Eureka in the spring.

Projects and Surveys.

Tacoma, Olympia & Chehalis Valley.—A press report states that this company will begin work on their proposed road from Gray's Harbor to a point on the Columbia river in eastern Washington at an early date. The principal offices are at Tacoma, W. T.

Santa Ana & Long Beach.—Chief Engineer HALEY is at work on the preliminary surveys. The length of the road is about 20 miles, and the estimated cost of construction, including bridges, is $200,000. The greater part of the right of way has been obtained.

Santa Clara Belt.—A charter has been granted M. H. PURRIL, A. MALPAS, G. T. BIGELOW and others to build a line of railway from Saratoga, Cal., to Santa Clara and San Jose, a distance of 12 miles. It stated that the surveys are finished.

RAPID TRANSIT.

Elevated Railways.—*Jersey City, N. J.*—A company has been organized with a capital stock of $600,000, to build an elevated road from the Jersey Central ferry to Bergen Hill. The Jersey Central Ry. Co. is interested. The designs have been prepared and the iron contracts have already been awarded. The trestles are to be such as are used on the New York elevated roads. No locomotives will be employed. The cars will be operated by cables such as are now used by the Hoboken elevated.

Hoboken, N. J.—The North Hudson County Ry. Co. proposes to extend its elevated line about 1½ miles.

Dallas, Tex.—A party of Kansas City capitalists have determined to build an elevated railroad through Elm street, the best business street in Dallas, provided they secure the right of way. It will be met with vigorous opposition.

Electric Railways.—*Brunswick, Me.*—The Brunswick Electric Ry. Co. has been incorporated by F. H. WILSON, J. P. WINCHELL, C. P. STOREY, and others to build an electric line to Harpswell and Topsham.

Boston, Mass.—The Boston Elevated Electric Ry. Co. has applied to the Legislature for a charter.

Seneca Falls, N. Y.—The Thomson-Houston Electric Company is trying to secure the right of way to operate an electric road between here and Waterloo.

Rochester, N. Y.—The contract for the equipment of the new electric railway from this city to Charlotte has been awarded to the Thomson-Houston Company of Boston, and the company agrees to complete its contract by June 1. There will be 16 cars, equipped with two motors of 15 H. P., each and the overhead wire system of propelling the cars will be used.

Edgewater, N. Y.—A New York syndicate has made application to the Edgewater Board of Village Trustees of Edgewater, Staten Island, for the charter for an electric motor railroad, from Sea Ave., Clifton, along the South Beach Boulevard to New Dorp.

Plainfield, N. J.—The Common Council has granted to Mr. LEO DAFT the exclusive franchise for a street railway in the city, and he will at once begin to build the line, which will be operated by electricity on the storage battery system.

Pittston, Pa.—An electric railway, 6 miles long, is to be built.

Chattanooga.—Application has been made for a charter for an electric railway to the battle-field of Chickamauga. It will be 10 miles long, will be operated by electricity, and will cost $200,000.

Youngstown, O.—An electric railway, 2 miles long, is to be built by a syndicate which has recently acquired control of the street railway system.

Milwaukee, Wis.—It is stated that the Milwaukee City Railway Co. intends to run its cars by electricity. It is also expected that a street car lighted and propelled by electricity will shortly be exhibited. This car is being fitted up in Detroit with storage batteries manufactured under the Woodward patents, the rights of which, for Wisconsin and Upper Michigan, have been secured by the Wisconsin Storage Battery Co., a Milwaukee corporation with a capital stock of $50,000. President, H. H. STAFFORD; Vice President, A. G. WEISSERT; Treasurer, DE WITT DAVIS; Secretary, H. T. WEST.

Omaha, Neb.—The Omaha Motor Ry. Co. has been reorganized and proposes to adopt an electric system. Capital stock, $500,000. President, Dr. S. D. MERCER; Secretary, WM. MILLARD; Engineer, W. L. ADAMS.

Cable Railways.—*Pittsburg, Pa.*—The Pittsburg Allegheny & Manchester Ry. Co., which controls the horse-car line over the 6th St. bridge, will build a cable line between Pittsburg and Allegheny, and the bridge company is having plans made for the necessary alterations to the roadway.

Tacoma, Wash. Ty.—Mr. THOMPSON, who put in the cable roads at Seattle, is negotiating with the street railway syndicate for converting some of the lines to the cable system.

Street Railways.—*Hartford, Conn.*—The Hartford & Wethersfield Street Ry. Co. will extend its line to Parkville.

Bay City, Mich.—The street railway company will build 3 miles of extensions in the summer.

Fond du Lac, Wis.—The street railway franchise has been sold to capitalists of New York and Chicago, who will, it is reported, build 4 miles of road next summer.

Santa Clara, Cal.—The Santa Clara Belt Ry. Co. has been incorporated to build a line to San José and Saratoga, 12 miles, by M. H. TURRILL, G. T. BIGELOW, and A. MALPAS. Capital stock, $300,000.

Walla Walla, Wash. Ty.—A street railway franchise has been granted to Messrs. JOHNSON, HOLMES, BAUMEISTER, and REES, who will begin work next month.

Eugene City, Ore.—The Pioneer Street Ry Co. has been organized by J. A. STRAIGHT, J. S. WASHBURNE, E. C. SMITH, and others. Capital stock, $20,000.

CONTRACTING.

Stone.—The following proposals for furnishing and placing stone on breakwaters were opened Feb. 12 by Lieut. Col. JARED A. SMITH, U. S. Engineer Office, Portland, Me.: At mouth of the Saco river, Me. Geo. W. Andrews, Biddeford, Me., 87 cts. per ton for first and second class stone; F. L. Andrews, Biddeford, Me., $1.03; J. A. Hamilton & R. A. Soule, Chebeague, Me., $1.37; H. M. Sargent & I. H. Webb, Chebeague, Me., $1.42 and $1.38; C. H. Bragdon & Co., Biddeford, Me., $1.47; J. F. Curit & A. E. Hamilton, Chebeague, Me., $1.49; T. A. Rowe, Boston, Mass., $1.49.——At Rockland, Me. J. F. Hamilton, Chebeague, 99½ cts. per ton; T. A. Rowe, Boston, 97 cts.; J. F. Curit, Chebeague, $1.02; J. A. Hamilton & R. A. Soule, Chebeague, $1.05; Bodwell Granite Co., Rockland, $1.06.

River Improvement.—The following proposals for removing overhanging trees, snags, etc., from the channel and banks of the Mississippi river, between Aitken and Grand Rapids, Minn., were opened Feb. 7 by Major C. J. ALLEN, U. S. Engineer Office, St. Paul, Minn.: Winston, Bros., Minneapolis, Minn.; removing overhanging trees, 7 cts. each for 4 ins. diameter to $1.50 for 42 ins.; removing snags, 25 cts. each for 4 ins. diameter to $20 each for 42 ins.; removing logs, 45 cts. each; removing bowlders, $2 per cu. yd.; total, $6,233.50.——Samuel McDonald, Casselton, Dak.; trees, 25 cts. to $3; snags, $1.50 to $4; logs, $3; bowlders, $10; total, $9,194.45.——S. J. Truax, Hastings, Minn.; trees, 30 cts. to $9; snags, $1 to $45; logs, $3 bowlders, $30; total, $18,667.40.

Dredging.—The following proposals for dredging about 300,000 cu. yds. of soft material and 500,000 cu. yds. of sand and clay, for improving the channel leading to the harbor at Baltimore, Md., were opened Feb. 14 by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Baltimore, Md.: Geo. C. Fobes & Co., Baltimore, 25 cts. per cu. yd.; Atlas Dredging Co., Wilmington, Del., 27 cts.; National Dredging Co., Wilmington, Del., 27¾ cts.; P. Sanford Ross, Jersey City, N. J., 28 cts.; Morris & Cummings Dredging Co., New York City, 29 cts. The amount available for the contract is $300,000, and all the bids were rejected as too high.

Pipe.—The Water-Works Department, of St. Louis, Mo., has awarded a contract for 800 tons of cast-iron pipe to the Shickle, Harrison & Howard Iron Co., at $21,064.

Excavation. — The contract for excavating 300,000 yds. of earth for a ditch 40 ft. wide and 10 to 30 ft. deep has been awarded to Wright & Wallace, of Lafayette, Ind., at 8 cts. per cu. yd. LEWIS STOCKETT, of St. Louis, is Chief Engineer, A. F. BUNKER, of Danville, Ill., is Superintendent.

Stop Gates and Fire Plugs.—The Water Department, Allegheny, Pa., has awarded the contract for 681 stop-gates, 4 to 12 ins. diameter, to the Rensselaer Mfg. Co., of Troy, N. Y., for $9,439.80. The contract for 150 fire plugs was let to J. R. Hutchinson, of Allegheny, at $25 each.

Trenching. — At Richmond, Va., the Gas Committee has awarded the contract for trenching and back filling to A. L. Phillips, and for repaving street over trenches to A. Ricks.

Arsenal. — The Chief of Ordnance, U. S. A., has awarded contracts to Elnathan Sweet, of Albany, N. Y., for the construction of the railway, the iron bridge and abutments and the excavation and grading for the new gun factory workshops at Watervliet arsenal, West Troy, N. Y., amounting to $34,900.

Lighthouses.—Sooysmith & Co., of New York, have been awarded contracts for lighthouses on Deer island, in the harbor at Boston, Mass., Lubec Narrows, Me., and Crabtree ledge, Me., at $18,300, $25,500, and $18,000 respectively.

Tunnel.—City Surveyor DOCKWEILER, of Los Angeles, Ca ., has presented plans for the proposed 3d St. tunnel. Th lans contemplate a tunnel 1,080 ft. in length, to cost bout $150,000, if constructed of brick and stone; if constructed of timber, the cost would be about $100,000. In th latter case, the tunnel could not be considered as a permanent fixture, and would involve a considerable outlay for annual repairs. The roadway would be 26 ft. in width, and the sidewalks on either side 8 ft. each. The height at the center of the tunnel would be 27 ft.; the walls running up perpendicularly 6 ft. before the spring of the arch. The work will take from 6 months to a year. An open cut through the same distance would cost about $250,000 and would ruin a great deal of property.

Armory.—The Armory Commissioners, Boston, Mass., have awarded the contract for the armory at Worcester, Mass., to the lowest bidders, Cutting & Bishop, at $84,569.

Sea Wall.—The following proposals for repair of sea-wall and slope of water battery at Fort McHenry, Md., were opened February 14 by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Baltimore, Md.: George P. Nardin, Baltimore, 200 cu. yds. of wall taken down and rebuilt, $2.10 per cu. yd., 250 lin. ft. of face of wall, excavation and refilling at rear, also protection of slope of water battery to prevent further sliding, 35 cts. per lin. ft.; 400 cu. yds. of excavation and refilling, 65 cts. per cu. yd.; 100 lin. ft. of 3-in. tile drains, 10 cts. per lin. ft.; 220 lin. ft. of coping reset and bedded in cement, 35 cts. per lin. ft.; 100 cu. yds. of rip-rap stone, $2.87 per cu yd.; 40 cu. yds. of new stone for wall, $3.35 per cu. yd.; 250 sq. ft. of flagstones for foundation stones, 10 ins. thick by 5 ft. long, 65 cts. per sq. ft.; total, $1,179.70.——Owen Patterson, Baltimore: wall, $3.75; face of wall, 65 cts.; excavation and filling, 75 cts.; tile, 7 cts.; coping 60 cts.; rip-rap, $4; new stone, $6.25; flagstones, 75 cts.; total, $2,188.50.——John Keaney, Baltimore: wall, $4.90; face of wall, 90 cts.; excavation and refilling, 70 cts.; tile, 27 cts.; coping, 75 cts.; rip-rap, $4; stone for wall, $6.50; flagstones, 40 cts.; total, $2,437. The contract was awarded to Geo. F. Nardin.

Removing Ledge.—The following proposals for removing ledge in Portsmouth harbor, N. H., were opened Feb. 12 by Lieut. Col. JARED A. SMITH, U. S. Engineer Office, Portland, Me.: O. J. Jennings, Fulton, N. Y., $11 per cu. yd. measured *in situ*; Thos. Symonds, Leominster, Mass., $15; S. S. Andrews, Biddeford, Me., $17.45; Geo. Townsend, Boston, Mass., $17.99; Thos. A. Rowe, Boston, $24.75.

Piles and Plank.—The following proposals have been received by the Docks Commissioners, New York: For 270 piles; Alfred Murray, $7 each; Beard & Kempland, $7.50. Contract was awarded to A. Murray.——For spruce plank; J. W. Duryee, $19.87 per M.; Dodge & Co., $20 and $22.50; Bell Bros., $24. Contract awarded to J. W. Duryee.

Docks.—Dear & Hayes have sublet the contract for the excavating for the entrance to the westerly docks of the Eastern Minnesota Ry., at Duluth, Minn., to J. J. Elliott. Dear & Hayes have commenced to build and sink the cribs at the back of the docks and will also build and have in readiness to put in place the cribs for the slip front as soon as it can be dredged. Timber is also being got out for the upper works of the docks.

Street Work.—*Baltimore, Md.* The following proposals were received February 12, by A. E. SMYRK, City Commissioner:——Gutter plates: J. V. Campbell, 1 3-16 cts. per lb.; John Watz, 1¼ cts. Contract awarded to J. V. Campbell.——Paving stones; James H. Atkinson 21 cts. per sq. ft. for flagstones, $1 per sq. yd. for Belgian blocks; John Harris, 22 cts., $1.25; John Curley, 23 cts., $1.25. Contract awarded to J. H. Atkinson.——Gutter stone; John Harris, 13 cts. per lin. ft.: J. G. Schwind, 15½ cts.; John Curley, 19 cts. Contract awarded to John Harris.——Cobble stone: James H. Atkinson, $1.29 per perch; Bergman & Peddicord, $1.40; John Harris, $1.40; J. G. Schwind, $1.42¾; David Leonard, $1.50; John Curley, $1.60. Contract awarded to J. H. Atkinson.——Curbing for Mt. Royal Ave.; Gill & Johnson, 95 cts per lin. ft. for straight curb, $1.05 per lin. ft. for curves, $1.70 per lin. ft. for circles; Woodstock Granite Co., $1.24, $1.39, $2.13; F. F. Graham, $1.87, $1.97, $3.25; W. F. Weller, $1.44 average.

Kansas City, Mo.—Contracts have been awarded as follows by the City Engineer: T. A. Butler, 14 cts. per cu. yd. for embankment, 40 cts. per lin. ft. for pipe; Dwyer & McFarland, 15 cts. for embankment, 60 cts. for rock, 30 cts. for pipe; W. F Croly, 14 cts. for embankment, $1.15 for pipe; John. A. Newcomb, 15 and 16 cts. for excavation.

Toronto, Ont.—The Board of Works has decided to lay asphalt pavements on various streets to cost $74,972 and cedar block pavements to cost $20,908; also improvements to Jarvis street to the extent of $130,480, of which the city will pay $12,730 and the property owners the balance.

PROPOSALS OPEN.

Depot.—Brick passenger station, 3 story, 28 ft. by 100 ft. at Hartford. Architect, BROOKS M. LINCOLN, of Hartford. S. B. ORDYKE, General Superintendent, Hartford & Connecticut Western R. R., Hartford, Conn. February 25.

Drawbridge.—Iron drawbridge across the Nocksack river. BELLINGHAM BAY RY. & NAV. CO., Whatcom, Wash. Ty.

Electric Lighting.—A franchise will be granted to the successful bidder, - Arc, incandescent, or combination plant. GEO. R. HURD, Mayor, Monroe, Mich. February 25.

Machine Tools.—For the Washington navy yard JAMES FULTON, paymaster general, Navy Department, Washington, D. C. February 26.

Pumping Engine.—GEO. H. FELIX, Secretary, Board of Water Commissioners, Reading, Pa. February 26.

Hydrants, Etc.—About 55 double nozzle hydrants, 10,000 lbs. of pneumatic stop-cock brass castings, 6,000 lbs. of 3-16-in. brass tubing. B. D. MCCONNELL, Superintendent of Water-Works, Montreal, Canada. February 26.

Wood Paving. — Cedar blocks; wood curbing. WM. BUCHANAN, Chairman, Street Committee, Gladstone, Mich. March 1.

Brick Paving. — Specifications on file at the office of JOHN A. GEORGE, C.E. WILL. H. GRIGGS, City Clerk, East Liverpool, O. March 2.

Bridge Work. — Weatherboarding and covering 2 bridges. JOHN C. FOSTER, Chairman, County Commissioners, Rome, Ga. March 4.

Curbing and Sidewalks.—Work for current year R. M. CLAYTON, City Engineer. M. MAHONEY, Commissioner of Public Works, Atlanta, Ga. March 4.

Well.—At the present water-works. THE CITY CLERK, Delaware, Ill. March 5.

Bridge.—At the Grand Narrows, Cape Breton. A. P. BRADLEY, Secretary, Dept. of Railways & Canals, Ottawa, Canada. March 6.

Sewers. — In 3 sections: (1) about 3,650 ft. of 24-in. to 36-in. brick, 1,240 ft. of 9 to 18-in. pipe, 600 ft. 12-in. pipe culvert, 24 catch basins, 26 manholes; (2) about 1,680 ft. of 24 to 36-in. brick, 150 ft. of 12-in. pipe culvert, 5 catch basins, 1 receiving basin, 9 manholes; (3) about 130 ft. of 24-in. brick, 1,600 ft. of 12 and 15-in. pipe, 150 ft. of 12-in. pipe culvert, 7 catch-basins, 9 manholes. A. B. HILL, City Engineer, New Haven, Conn. March 6.

Water Pipe.—(See advertisement.) W. H. RICHARDS, Engineer of the Water Board, New London, Conn. March 6.

Pier Work.—(See advertisement). THE PARK COMMISSIONERS, 87 Milk St., Boston, Mass. March 8.

Building.—Government building at Troy. M. F. CUMMINGS, Architect, Troy, N. Y. March 9.

Water Pipe.—About 1,550 tons of cast-iron pipe. B. D. MCCONNELL, Superintendent of Water-Works, Montreal, Canada. March 12.

GOVERNMENT WORK.

Dump-Boat.—For the Great Kanawha river improvement. Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, W. Va. February 28.

Cement.—About 4,400 bls. of Portland cement. Major W. S. STANTON, U. S. Lighthouse Engineer, Boston, Mass. March 2.

MANUFACTURING & TECHNICAL.

Pole Railway.—JOHN MEAGHER, of Frankfort, Ky., will build about 10 miles of pole road, and wants to correspond with builders of engines, cars, etc.; for this class of road.

Locomotives.—The Taunton Locomotive Mfg. Co., of Taunton, Mass., is building for the Boston, Revere Beach & Lynn road 2 "Mason bogie" or "Fairlie" engines; the road is equipped with this peculiar style of engine, of which the Mason Machine Works, of Taunton, are the original builders in this country and the patentees. The type is similar to the Forney type, but the driving wheels are carried in a swiveling frame.

The Brooks Locomotive Works, of Dunkirk, N. Y., have turned out 10 moguls for the Lake Erie & Western.

The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered 6 large engines to the Denver & Rio Grande.

The Union Pacific Ry. has turned out a new engine from its shops at Armourdale, Kan.

The Mexican Ry. has ordered several Fairlie locomotives from England.

Cars.—The U. S. Rolling Stock Co. of Anniston, Ala., is building a number of flat-cars for the Jeffersonville, Madison & Indianapolis. They are equipped with the American continuous draw-bar.

The Gilbert Car Co. of Troy, N. Y., has recently finished 6 passenger cars for the Delaware & Hudson.

The South Baltimore Car Co., of Baltimore, Md., has built 200 gondola cars for the Baltimore & Ohio.

The Muskegon Car Co., of Muskegon, Mich., has built 10 Zimmerman automatic refrigerator cars.

The Ohio Falls Car Co., of Jeffersonville, Ind., has a contract for 1,000 box cars for the Pennsylvania, and a large order for coke cars for the Tennessee Coal & Iron Co. Several passenger cars are also being built.

The Chicago, Milwaukee & St. Paul will shortly let contracts for 100 refrigerator cars.

The Philadelphia & Reading has ordered a number of fruit cars.

Railway Material.—H. C. Williams & Co., of Duke, Ga. want about 5 miles of second-hand 40-lb. steel or iron rails.

F. H. Waring, of Cement, Ga., wants rails and ore cars, for a line ¾ mile long.

J. N. Pharr, of Berwick, La., will build a narrow gauge plantation line.

The McCall Bros. Planting & Mfg. Co., of McCall, La., wants cars and 16-lb. rails for a 3-ft. gauge plantation line 2 miles long.

The Highland Improvement Co., of Helena, Ark. wants a light dummy engine and 4 flat cars.

The American Bridge & Iron Co. has been organized at Roanoke, Va., to undertake the construction of bridges, furnaces, etc. The engineers of the company are CHAS. C. WENTWORTH and JOSEPH L. HUNTER.

The Pneumatic Railway Co. has been organized at Nashville, Tenn., by CHAS. WALTON, CHAS. J. RAINER, and others, of Philadelphia, Pa., to manufacture motors, etc.

Petroleum Fuel.—The Texas Fire Clay Mfg. Co., of Fort Worth, Tex., is introducing a "fire log" which can be used for engine furnaces, stoves, etc. It consists of a hollow perforated cylinder, filled with crude petroleum which is supplied from a reservoir.

Pneumatic Bell Ringer.—The master mechanic of the Chicago & Eastern Illinois road has invented a device for ringing the bell of a locomotive by compressed air from the brake reservoir.

Tanks.—The Nashville, Chattanooga & St. Louis Ry. Co. will erect large tanks at Tullahoma, Tenn.

Signals.—A company has been organized at Greenville, S. C., to manufacture the automatic railway signal invented by H. O. KING.

The Jagger Iron Works, in the town of Bethlehem, near Albany, N. Y., were sold at auction recently and bought by P. J. McArdle, of Albany, for $30,100. The property covers 8 acres, and includes blast furnaces and complete plant.

The Newport Aluminum & Steel Co., of Newport, Ky., is prepared to grant licenses for the cheaper production of soft steel and malleable iron castings without annealing in ordinary cupola furnaces, by the new ferro-aluminum process.

Girder Rails.—The Johnson steel girder rail, manufactured by the Johnson Co., of Johnstown, Pa., has been adopted by the Canal & Claiborne Street Ry. Co., of New Orleans, La.

The Pond Engineering Co., of St. Louis, Mo., has issued an illustrated pamphlet descriptive of its steam plants for electric lighting, railways and power of giving a number of testimonials.

Balanced Valve.—The Pittsburg & Lake Erie road has been experimenting with the Ferguson balanced valve, and has now applied it to 5 more of its locomotives. It is the invention of JAMES FERGUSON, of Bridgewater, Mass.

The Harvey Steel Co., of Newark, N. J., has completed its works and will begin operations shortly, having a number of orders on hand. The process to be used is the invention of Mr. H. A. HARVEY, President of the company. A specialty will be made of treating all kinds of drop dies, rolls and forgings used in pressure work, etc., made from Bessemer steel, the company warranting to make them equal to crucible steel. By this process, dies are guaranteed not to crack in tempering, the treatment leaving no scale or roughness on the surface. The greater ease and less cost in making and cutting dies from soft Bessemer, and less cost in original stock as compared with cost of cast steel, are the principal advantages.

Creosoting Works.—The works of the Puget Sound Creosoting Co. at Salmon Bay, about 6 miles north of Seattle, Wash. Ty., are nearly completed. The wharf is finished, and 7 corrugated iron buildings are being built. The machinery has been ordered from the Richmond Machine Works, of Richmond, Va. There will also be an electric light plant, as the works will run day and night; a system of tracks with locomotive for hauling piles, etc.; also 4 steam pumps with capacity of from 450 to 800 galls. per minute. Total cost of plant $125,000. E. RICKENBECKER is manager.

The "Monadnock."—The Secretary of the Navy has awarded the following contracts for materials for use in constructing the U. S. monitor *Monadnock* at the Mare Island navy yard: William F. Whittier, San Francisco; white lead, $407; zinc paints, $227; colored paints, $861.05. Albert Tyler, New York: brass and iron screws, $469. Standard Steel Casting Co.: steel castings for turret, $11,032. A. Powell, New York: white oak, $2,730. Gibbs & Selfridge, San Francisco: wrought-iron, $1,302. Austin & Phelps, San Francisco: steel angle bars for hull, $1,190. Park Bros. & Co., Pittsburg: steel plates for hull, $4,835; steel plates for turret, $8,104. Cramp Bros., Philadelphia: composition castings for turret, $2,321. Robert Wetherell & Co., Chester, Pa.: iron castings for turret, $1,560. Wm. Walker, Vallejo, Cal.: Oregon pine logs, $11,118; redwood planks, $3,169; white ash, $2,262; black walnut, mahogany, etc., $2,713; cypress and cedar, $1,000. Dunham, Carrigan & Hayden Co., San Francisco: hardware, $2,670; bulb T bars for hull, $1,258.

Machine Shops.—The new shops at Ludlow, Ky., for the Cincinnati, New Orleans & Texas Pacific, have been completed. There are machine, erecting, boiler, blacksmith and tin shops, and a foundry. These are the most extensive works on the Queen & Crescent system, and Mr. MEEHAN, the Superintendent of Motive Power, states that locomotives will be built there at once.

Construction Companies.—The Lake Construction Co. has been organized at Chicago by J. C. MCSHANE, W. W. MENDENHALL, and W. D. ROSE, to build railways, bridges, etc. Capital stock, $520,000.

The Kentucky & Tennessee Construction Co. has been organized by L. M. RICE, M. J. BRAY, and others, to build railways, canals, bridges, etc. Capital stock $50,000.

The Central Water-Works Construction Co. has been organized at Kansas City, Kan., with a capital stock of $50,000. President, O. B. GUNN; Vice President, A. N. MOYER; Secretary, H. B. POMEROY. W. KIERSTED, of Kansas City, Mo., is the Chief Engineer.

Car Works.—The Interstate Rolling Stock Construction Co. has been organized at Chicago by W. F. and W.S. BREWSTER and W. BRADBURY. Capital stock, $500,000.

The Springfield Car & Foundry Co. will build extensive works at Springfield, O., for the manufacture of freight cars, car wheels, etc. F. B. SMITH, T. HORNSBY, and B. F. HOBART are among the directors.

The Atlanta Car Co. has bought 15 acres of land for the site of its works at Atlanta, Ga. D. C. BACON is at the head of the enterprise.

The Lima Car Mfg. Co., of Lima, O., has its works in operation again, the strike having been declared off.

Car works are projected at Suffolk, Va.

The Harris Patent Track Laying Machine has been in use for about 8 years, and has laid about 6,000 miles of track in this country and Canada. A testimonial from the Chicago, Kansas & Nebraska Ry. states that the cost of laying track during the months of July, August, and September was $150 per mile, exclusive of cost of loading and train services. Each gang averaged 100 men and laid a little over 1¼ miles per day, the highest record being 13,700 ft. in 8 hours and 47 minutes. The machine does away with all team work. Two rail lengths, 60 ft., are laid at a time and lightly spiked; the train is then moved forward 60 ft., and the operation is repeated, while the remainder of the spiking, securing bolts, and lining, are done after the train has passed over each 60 ft. section. The machines are leased on royalty by the mile. The proprietors are HARRIS & Co., 188 Wabash Ave., Chicago, Ill.

BRIDGES AND CANALS.

Bridge Notes.—*Arkwright, R. I.*—The new bridge over the Pawtucket river has been completed, at a total cost of $4,889. It is an iron structure, 125 ft. long and 20 ft. wide, with masonry abutments. Mr. JOSEPH A. LATHAM was the engineer.

Greenbush, N. Y.—The plans for a bridge over the railway tracks at the Broadway crossing provide for a five-span structure, which will cost $75,848. The total length of the bridge will be 687 ft., and it will be 37 ft. wide. It is to be built of steel.

Elizabeth, N. J.—Work has been commenced on the timber for the Jersey approach to the Baltimore & Ohio bridge, at Elizabethport and Roselle, the latter point being where the Baltimore & Ohio joins the Jersey Central. The trestle will be about 3 miles long, and will run the greater part of the distance across the Salt Meadows.

Beaver Falls, Pa.—The Oak Hill Bridge Co. has been organized as follows: President, H. W. REEVES; Secretary and Treasurer, JOHN P. REEVES. The capital stock is $50,000.

New Brighton, Pa.—The Tenth Street Bridge Co. has been organized with these officers: President, JOSEPH WILSON; Secretary and Treasurer, JOHN P. REEVES. Capital stock, $50,000.

Riverton, Pa.—McKeesport capitalists have applied for a charter for a bridge across the Monongahela at this place.

Charleston, S. C.—Work is again progressing on the new city bridge, having been delayed by high water. It will probably be completed by June.

Big Rapids, Mich.—The second new iron bridge over the Muskegon river has been completed.

Chicago, Ill.—The contract for the Clarke St. bridge has been awarded to the Variety Iron Works, of Cleveland, O.

LaCrosse, Wis.—The vote taken Feb. 12 on the proposition to issue $70,000 in bonds for a wagon bridge across the Mississippi, resulted in 2,545 favorable votes out of a total of 7,935.

Antonito, Col.—A county bridge will be built across the Conejos river about 6 miles west of this place. It will be 400 ft. long and will be built of wood.

Portland, Ore.—The Portland & East Portland Bridge Co. has been incorporated by A. HAROLD, J. D. CROZIER, and J. A. ALLMIRE. Capital stock, $200,000.

Willamette River.—The Portland & Willamette Ry. Bridge Co. has been incorporated at Portland, Ore., by WM. REID, JOHN MCGUIRE, and D. W. CUMMINS, to build a bridge over the Willamette river between Marion and Yamhill counties, near Ray's landing. Capital stock, $250,000.

Quebec, Canada.—Mr. WALTER SHANLEY's report on the surveys of the different sites for the proposed bridge over the St. Lawrence is now before the directors of the bridge company.

The Variety Iron Works, of Cleveland, O., have a contract for a large bridge at Cincinnati, O., and for several bridges in the South.

Culvert.—The Scioto Valley Ry. has let the contract for a large stone culvert over Beaver creek, 2 miles below Piketon, O. The work will cost about $12,000.

Seneca River Improvement.—In May, 1888, the New York State Legislature passed an act providing for dredging and excavating the channel of Seneca river, the old Bear race, at Waterloo, to facilitate the passage of canal boats, and $15,000 was appropriated. Superintendent SHANAHAN advertised for bids and the work was given to Fuller & Albough, of Rochester, for $12,875. Work was commenced in January and continued until recently when it was stopped by an injunction, petitioned for by A. M. PATTERSON. The flouring mills, at the lower end of the improvement proposed, would be greatly benefited by an increased water supply, but Mr. PATTERSON draws water from the canal lower down, and thinks that his water privileges were being injured.

The Mississippi River & Gulf Canal Co.—A meeting was held recently at Meridian, Miss. President ISIDORE HERNSHEIM; Vice President, B. F. ESHLEMEN. The company has purchased a tract of land above the city limits, between Carrollton and Southport, measuring 384 ft. front on the Mississippi river by 7,680 ft. toward the lake, for $50,000. The entire length of the canal will be about 4 miles. It will be valuable for the commerce of New Orleans, as commodities of Alabama, Mississippi, and the lake coast can be transferred by water to the shipping in the harbor of New Orleans. Major B. M. HARROD, of New Orleans, who is making a survey of the proposed route, stated that the cost of the canal would be between $250,000 and $300,000.

Kansas City, Kan.—Although 12 bridges span the Kaw river from its confluence with the Missouri to the city limits, there is a growing demand for additional bridges, and three new ones will be built in 1889, while iron structures will take the place of two old wooden bridges. The bridge building boom began in 1887, when four new bridges were built. In 1888 two more were added, and now the increasing travel has created a demand for others. The bridges now in use are the Kansas City, Wyandotte & Northwestern Railway, the Union Pacific Railway, the Belt Railway, the Rock Island Railway, the Interstate Elevated Railway, the Metropolitan Street Railway, the water-works company's bridge, the stock yards bridge, and the city and county bridges at James street, East Kansas avenue, 24th street, and the southern bridge. Bills are now in the hands of the State Legislature providing for bridges at the east end of Osage avenue and at the southern terminus of 8th street. The former will be used by a street railway company if built, while the latter is intended to open up a direct thoroughfare to the city of Rosedale. A franchise ordinance has been introduced in the city council by the Kansas City, Wyandotte & Northwestern, for a line along the bluff and across Riverside, which, if passed, will secure a bridge at the terminus of East 7th street, or about midway between the Elevated Company's bridge and the Union Pacific bridge. In addition to these proposed bridges a bill has been introduced in the House, providing for a combination railway and wagon bridge across the Missouri river at the northeastern limits of the city. This bridge will be built for the Chicago, Omaha & Kansas City Railway Company, and it is probable that it will be used by other lines. The county commissioners have let the contract for tearing away the old southern bridge, and it will be replaced by a new iron structure as soon as the work can be done. The old bridge at the eastern terminus of Armourdale is not heavy enough for the travel to Armourdale and an effort will be made at once to have it rebuilt. If this is not done, the Metropolitan Street Railway Company will be compelled to build a bridge for the new Armourdale electric system. There is also a great deal of talk about the construction of a new bridge across the Kaw, at Turner Station and at Bonner Springs. A bill has been introduced for the latter bridge by Senator BUCHAN, and a committee of influential citizens will go to Topeka to urge the passage of a a bill for the former bridge.

ELECTRICAL.

Electric Lighting.—*Danvers, Mass.*—The city has put in a plant of its own. The $15,000 bonds for the work have been awarded to Brewster, Cobb & Esterbrook of Boston, at 64 cts. premium per $100.

Lenox, Mass.—An electric light company has been organized, with a capital stock of $50,000. There will be 4,000 lights on the Westinghouse system. President, THOS. POST; Secretary, JAS. CLIFFORD.

Hingham, Mass.—The Weymouth Power & Light Co. has been granted permission to put up poles and wires.

Jamestown, N. Y.—A citizens' committee has been appointed to investigate the subject of establishing a municipal electric lighting plant.

Batavia, N. Y.—A franchise has been granted to an electric light company with a capital stock of $25,000. A Westinghouse plant for 1,000 incandescent lights will be put in.

Laurel, Md.—An electric light system is projected. For particulars address J. A. CLARK.

Piedmont, Md.—The Piedmont Electric Light & Power Co. has been incorporated by G. M. HARRISON, H. G. BUXTON, and others. Capital stock, $20,000.

Covington, Ky.—The Covington Electric Light, Heat & Power Co. has been organized. Capital stock, $15,000.

Concord, N. C.—A company has been organized to put in an electric light plant with a capacity of 500 incandescent lights. W. O. CRAVEN wants bids for plant.

Milledgeville, Ga.—An electric light company has been organized.

Fernandina, Fla.—The Fernandina Electric Light Co. will put in an arc and incandescent plant. President, F. W. HOYT; Secretary, S. D. SWANN.

Oxford, O.—The city has voted in favor of issuing bonds for $25,000 for an electric light plant.

Marietta, O.—The city has voted to put in a plant at a cost of $15,000.

Monroe, Mich.—The city will put in a plant of 50 arc lights. Bids will be opened Feb. 25 by the Mayor, GEO. R. HURD.

Red Jacket, Mich.—The Peninsula Electric Light Co., of Hancock and Houghton is making arrangements to put in a central electric light plant at Red Jacket. It is designed that the plant shall cover Calumet.

Benton Harbor, Mich.—The Benton Harbor & St. Joseph Electric Light Co. has been organized by I. W. CONKEY and J. B. MORRISON, of Benton Harbor: W. BALLENGEE and R. S. COLLINS, of St. Joseph; and W. W. BEAN and W. G. KEITH, of Cincinnati, O. Capital stock, $25,000. The plant will be located between the two towns, and arc and incandescent lights furnished.

Chicago, Ill.—The Thirty-first St. Merchants' Electric Light Co. has been organized by CHAS. EAST, A. LIVINGSTON, W. EDELSTEIN, and others. Capital stock, $20,000.

Racine, Wis.—The city has made a contract for 119 lights at $50 per annum each until midnight, and $75 per all night.

Kirkwood, Mo.—The Kirkwood Electric Light & Power Co. has been organized, with C. A. KITCHEN at its head. There will be 500 incandescent lights of 16 c. p. Capital stock, $5,000.

St. Charles, Mo.—An electric light franchise for 15 years has been granted to the gas company.

Jonesboro, Ark.—An electric light plant will be put in this spring by J. B. DILLON.

Montrose, Col.—The Montrose Electric Light Co. has been incorporated by F. W. HAMLIN, A. HEIBLER, and C. E. MCCONNELL, with a capital stock of $10,000.

Chehalis, Wash. Ty.—The water company will put in an electric light system with 500 incandescent lights of 16 c. p. The dynamos will be driven by the water-works engine. Mr. RAY is interested.

London, Ont.—A company is to be organized to put in an Edison incandescent plant. Capital stock, $250,000.

The Paris Exhibition.—The Heisler Electric Light Co. of St. Louis, Mo., has the contract for lighting the American section of the exhibition. The plant will consist of a dynamo of 1,000 incandescent lights capacity. Lamps will be exhibited of 10 to 300 c. p. The automatic regulation will be arranged so as to indicate the reduction of power when lights are turned off. Ten miles of circuit wire No. 8 will be inserted to indicate the practicability of carrying the current to any desired distance. A registering current meter will be included in the exhibit. Clusters of incandescent lights of various power will be suspended from the ceiling, the posts being provided

with side brackets such are used for indoor lighting, and there will also be 50 street lamp brackets to show a system of street lighting used in a number of American cities.

Honduras.—The Guyape Mining Co., of Truxillo, has purchased several arc and incandescent machines from the Van Depoele Electric Mfg. Co. The machines are to be made in sections for convenience of transport over the trails, and will be used in the mines.

WATER AND MUNICIPAL.

Water-Works.—*New Hampshire.*—Nashua. During 1888, there were 60 post hydrants set; it is proposed to replace all the old Perkins' hydrants with others of a different type.

Massachusetts.—Worcester. The city has been granted permission to issue additional water bonds for $300,000 for necessary enlargements and for the payment of damages caused by taking Tatnuck brook.—North Adams. The p oject for a new water supply is carried forward with success. It is decided to use a 24-in. pipe. The use of water at the present time is 1,000,000 galls. a day.—East Bridgewater. The Water Commissioners propose to dig a well 30 ft. deep and 10 ft. diameter for an additional supply.

New York.—Greenport. The Greenport water-works people have succeeded in finding an excellent quality of water and are making preparations to begin operations.

New Jersey.—Haddonfield. The Haddonfield Water Co. is considering a proposition to extend its mains to Collingswood.

Pennsylvania.—Uniontown. With regard to the item in our last issue, to the effect that the water company at Connellsville had been enjoined from using water from Cold Spring, we are asked to correct this statement, as Cold Spring is one of the sources of supply for the Uniontown Water Co., in the same county.

Virginia.—Roanoke. The south basin of the reservoir will be rebuilt in the spring; in the meantime the north basin holds an ample supply.

South Carolina.—Orangeburg. At the last meeting of the City Council a proposition to sell the present water works and let purchasers extend same and furnish the city with water for fire purposes from 100 hydrants at $25 each per annum, was considered. The proposition was rejected, and it was thought it would be better for the city to own the works, even if it has to issue bonds to extend the same, though no action was taken on the question of issuing bonds.

Georgia.—Atlanta. The most important work ahead for the present Council is to provide for a new water supply. There has been some correspondence on the subject with expert engineers, but no definite conclusion has been reached. As soon as an engineer is selected, he will make the necessary preliminary surveys and locate the source of supply. When this is done, the Council will make the necessary arrangements to commence the work.

Alabama.—Anniston. The Anniston Water Supply Co. has received a charter from the Legislature.

Mississippi.—Natchez. The stand-pipe will be 150 ft. high, and the well will yield a supply of 2,000,000 galls. per day.—Jackson. The water-works are in progress.

Louisiana.—Baton Rouge. The Baton Rouge Water-Works Co. has elected the following officers: President, WM. GARIG; Vice President, ANDREW JACKSON; Secretary and Treasurer, E. H. MYER, of Dubuque, Ia.; Superintendent, PAUL ANNIS.

Tennessee.—South Pittsburg. The South Pittsburg City Co. will erect a pumping station to supply the increased demand for water for the factories.

Kentucky.—Hopkinsville. The Council has appointed a committee to investigate and report upon the advisability of the city building water-works. For particulars address the mayor.—Mt. Sterling. Information in regard to the water-works can be obtained of Badger, Henry & Co.

Michigan.—Ishpeming. The water-works were more than self-sustaining during the past year. In addition to paying all the operating expenses, about $4,300 was expended in purchasing and laying new pipe, putting in new hydrants, plumbing expenses, etc., and a balance of $71.21 was turned over to the city treasury. The receipts of the water-works for the year were $8,642.70. During the past year 8,116 ft. of new pipe was laid, making the total mileage of pipe at the end of the year 10.79 miles.—Lansing. The water drawn from the new rock wells is clear and devoid of the iron taste which made the water from the first well distasteful to many. There is a strong feeling in favor of the water of the rock wells among the consumers, and it is expected that additional wells will be drilled, and the city supplied entirely with rock water.—Holly. The Holly Milling Co. has made the following propositions to furnish a supply of water: First, to run the water-works and keep forty pounds of pressure on the mains constantly, for $1,250 per year: second, to keep the pressure at thirty-five pounds for $1,200. The Council talked the matter over for some time, and came to the conclusion that it was to the best interest of the village, as a whole, to keep the pressure at forty pounds. A contract for one year on these terms was ordered. Mr. DOANE is manager of the company.

Indiana.—Columbus. The machinery for the new water-works plant is being placed in position. The cost of the plant will be about $15,000.

Illinois.—South Ottawa. The South Ottawa Water-Works Co. has been incorporated by T. C. FULLERTON, T. ELDRIDGE, C. B. HESS, and others. Capital stock, $30,000

Missouri.—Washington. The City Council has accepted the works built by the Interstate Gas & Water-Works Co., of St. Louis. The hydrant rental of $3,000 per year will date from Feb. 1.

Texas.—Fort Worth. The city had, on Jan. 1, 19 miles 1,345 ft. of mains, 127 hydrants, 50 gates, and 1,291 service pipes.

Colorado.—Littleton. It is intended to incorporate this place as a city and to put in water-works.

Washington Territory.—Chehalis. A company has been organized to build water-works. The supply will be taken from the Newaukum river, about 2¼ miles from the city, and forced by steam pumps with a daily capacity of 500,000 galls. to reservoirs on the hills east of the city, whence it will flow to the distribution pipes by gravity. President, JOHN DOBSON; Vice President and General Manager, H. A. RAY, of San Francisco, Cal.; Secretary, W. T. FORREST; Treasurer, J. W. FARR. Capital stock, $30,000.

California.—Gilroy. It is proposed to lay 18,277 ft. of 12-in. pipe, and 4,440 ft. of 10-in.—San Diego. Oakland capitalists are negotiating for the purchase of the water-works and a water-right from the flume company. The water-works are owned by a private corporation under the control of BABCOCK & STORY. A contract has been drawn up, the purchase price being put at $1,300,000, in which there is a special clause which extends to the city of San Diego a first option for the purchase until March 1. The city will have to call a special election to decide the question.

Utah.—Salt Lake City. The Committee on Water-Works has selected a site for the reservoir and recommended that the mayor be authorized to build the reservoir; the excavation will cost $7,000. Parties claiming to be the legal owners of the waters of City creek applied to have the water turned back into its original course, but the committee stated that to comply with their request and abandon the present water-pipe system would cause such immense loss, by percolation and evaporation, that the present supply would be totally inadequate to furnish water for domestic purposes to the present increased population of that portion of the city entitled to primary use of the water.

Canada.—Lachine, Que. The contract for the water-works has been signed by Mayor DAWES, and Lamontagne & Van de Vliet, the contractors. The contract price is $75,000, and work is to be commenced at once under the supervision of C. L. COUVRETTE, Superintendent of Construction. The filtering plant is to be erected at once.

Fitchburg, Mass.—The Water Commissioners have issued their report for the year ending Nov. 30, 1888. During the year 12,346 ft. of pipe were laid and 12 hydrants set, 2 for private parties; there are now 38.14 miles of pipe, 233 city hydrants, 35 private hydrants, 2,456 taps, and 157,677 ft. of service pipe. The total rainfall was 52.23 ins., being 16.28 ins. above the average. The total consumption was 475,000,000 galls. for an estimated population of 15,500 supplied; 21,744,057 passed through domestic meters, and 119,600,700 through manufacturers' meters. THOMAS C. LOVELL is Superintendent.

Brooklyn, N. Y.—Proposals have been received for the $600,000 of 3 per cent. water loan bonds, maturing in January, 1909, and the $1,000,000 of 3 per cent. local improvement bonds maturing at different dates from 1904 to to 1913. There were seven bids in all, the bidders being the Nassau Trust Co., the Dime Savings Bank, Vermilye & Co., D. Moran, Blake Brothers & Co., and Moller & Co. The entire lot of $1,600,000 worth of bonds was sold to Vermilye & Co. at their bid of $106.80 for the local improvement bonds and $105 for the water bonds.

Houston, Tex.—The new well of the water company has a flow of about 300,000 galls. per day. The well was bored under the direction of Mr. WARNECKE, and proved a quick and successful piece of work. At a depth of 154 ft. a good flow was obtained, but it was thought advisable to sink deeper. When the pipe had penetrated 14 ft. further, the flow measured about 50,000 galls. a day. At this point MR. WARNECKE decided to stop drilling and try a torpedo at 154 ft. where the first flow was obtained. A 10-lb. dynamite torpedo was lowered to the required depth and fired, the result being satisfactory in starting a plentiful flow.

Pawtucket, R. I.—The Water Commissioners have issued their report for the year ending Dec. 1, 1889. The new pumping station (No. 3), built during the year, completes the system originally contemplated. The results of analyses of the water have been satisfactory. The engine at the new station is of the twin compound type, with horizontal cylinders 20 and 40 ins. diameter and 40 ins. stroke; the daily capacity is 6,000,000 galls. When all the buildings are filled with pumps according to their capacity, they can pump 27,000,000 galls. per day. The new filter gallery is 108 ft. long and 20 ft. wide; there are 18 ins. of broken stone and 12 ins. of wood charcoal. The report contains a number of views of the works and a portrait of Superintendent EDWIN DARLING.

Filter Plant.—The filter plant put in at Mexico, Mo., by the National Water Purifying Co., of New York, is giving satisfaction. It combines the complete system of aeration, precipitation, and filtration.

Artesian Wells in Mexico.—C. S. GREEN, manager of the 2,000,000 acres Hacienda de Istra, in Chihuahua, has secured from the Mexican Government the exclusive right to bore artesian wells in the States of Durango, Chihuahua, and Cohuala, and is going to England for capital to push the enterprise. Vast mining districts are in the States named, which can be developed with water. Americans and other foreigners, as well as natives, who have valuable claims, will protest to the Mexican Government against such a monopoly.

Winona, Minn.—The Water Committee has recommended extensions of the mains; and in connection with the report, City Engineer FELLOWS submitted an estimate of the proposed water mains: Of 8-in. mains, 9070 ft.; on these 19 hydrants should be set, and for these 228 ft. of 4-in. pipe would be needed. Estimated cost as follows: 193 tons of pipe at $28, $5,404: 19 Mathews hydrants at $35, $665; water gates, $250; specials, $306; laying above work, $3,540; total expense of 8-in. pipe and hydrants $9,165. Estimate for 6-in. pipe, 13,430 ft.: on this the city would need 33 hydrants and about 396 ft. of 4-in. pipe. Estimated cost: 6 in. pipe, 232½ tons at $28, $6,510; 33 hydrants $1,155; water gates, $300; specials, $250; laying above work, $3,357; total expense, $11,502. The estimate covers about 4¼ miles of water mains, and the whole work complete will cost the city about $20,000.

Memphis, Tenn.—The expenditure of the Artesian Water Co. during the past year has been very large. The new plant, the steel reservoir, the six new wells, and the other improvements combined, represent about $500,000, and now the company has commenced work that will incur an additional outlay of $250,000, and will necessitate a removal of the machinery. The work is that of sinking an underground chamber, 45 ft. in diameter and 56 ft. deep, for the pumps. The bottom will be formed of concrete 11 ft. thick, and the walls will be of brick and cement. Through the concrete floor a 10-ft. shaft will be sunk 30 ft. lower. From this a number of tunnels will be run to each well pipe. These tunnels and the shaft will be walled with concrete. When the connections have been made, 4 pumps of 10,000,000 galls. capacity will be placed in the chamber to force the water from the shaft to the mains. The work of sinking the chamber, shaft, and tunnel is under the supervision of Mr. T. J. JOHNSTON, assisted by E. L. COOLEY and J. H. SPANGLER. It will occupy about twelve months. The steel stand-pipe is now 50 ft. high, and will be 150 ft. high when completed.

New Orleans, La.—The Council set apart $5,000 for repairs to the Bienville draining machine; bids were advertised for, but the only bid received was from JAMES COCHRAN, for $21,650 for a new plant. With his bid was a letter stating that $62,000 had been spent for repairs during the last 10 years, and the machine is in bad condition. His proposition is to put in an improved centrifugal pump with 6-ft suction and discharge pipes, driven by a triple expansion engine, capable of discharging 5,000,000 galls. of water per hour on a consumption of 2 lbs. of fuel per H. P., the whole discharging 1,000,000 galls. of water at a less cost than 45 cts. per 1,000,000 galls., which is the lowest estimate of the present system, and capable of raising the water to a height of 15 ft., or so much thereof as is necessary. The pump to be placed on suitable foundation instead of the small draining wheel in the Bienville machine, which the city can retain and sell, the proceeds to be applied in part payment of this contract. All to be in perfect running order within six months after signing the contract. Also to include a new battery of two boilers to be used in connection with the boilers of the present draining machine. The whole plant will be provided for the sum of $21,650, whereof $5,000 is to be paid under the present appropriation, and the balance to be provided for in the budget of 1890 among the regular appropriations.

Madison, Wis.—The Board of Water Commissioners has issued its report for the year ending Oct. 1, 1888. The report of the Superintendent, Mr. JOHN B. HEIM, dealing with the great proportion of waste and the difficulty of providing for it until meters were adopted, is both interesting and instructive. The waste was so great that a satisfactory fire pressure could not at all times be maintained, and various methods of increasing the supply were suggested. Inspection and agitation resulted in increasing the wastage. Finally a general meter system was adopted, the city furnishing the meters free to the consumer, charging no rental, and placing them gratis on all services then connected with the supply system, the intention being to control and save the water. The placing of meters was commenced in May, 1888, and in August there were 130 in use, and 210 at the time of the report. A wastage of 2,000 to 13,000 galls. a day, from leaky fixtures and constant flow, was actually found. Water can now be stored for a fire supply, and a storage basin of about 380,000 galls. capacity is recommended. The total pumpage was 257,682,300 galls., for a population of about 16,000. The supply is pumped direct from 8 artesian wells. The report contains a map of the city showing the sizes of the mains, etc., and also contains the ordinance and laws relating to water-works.